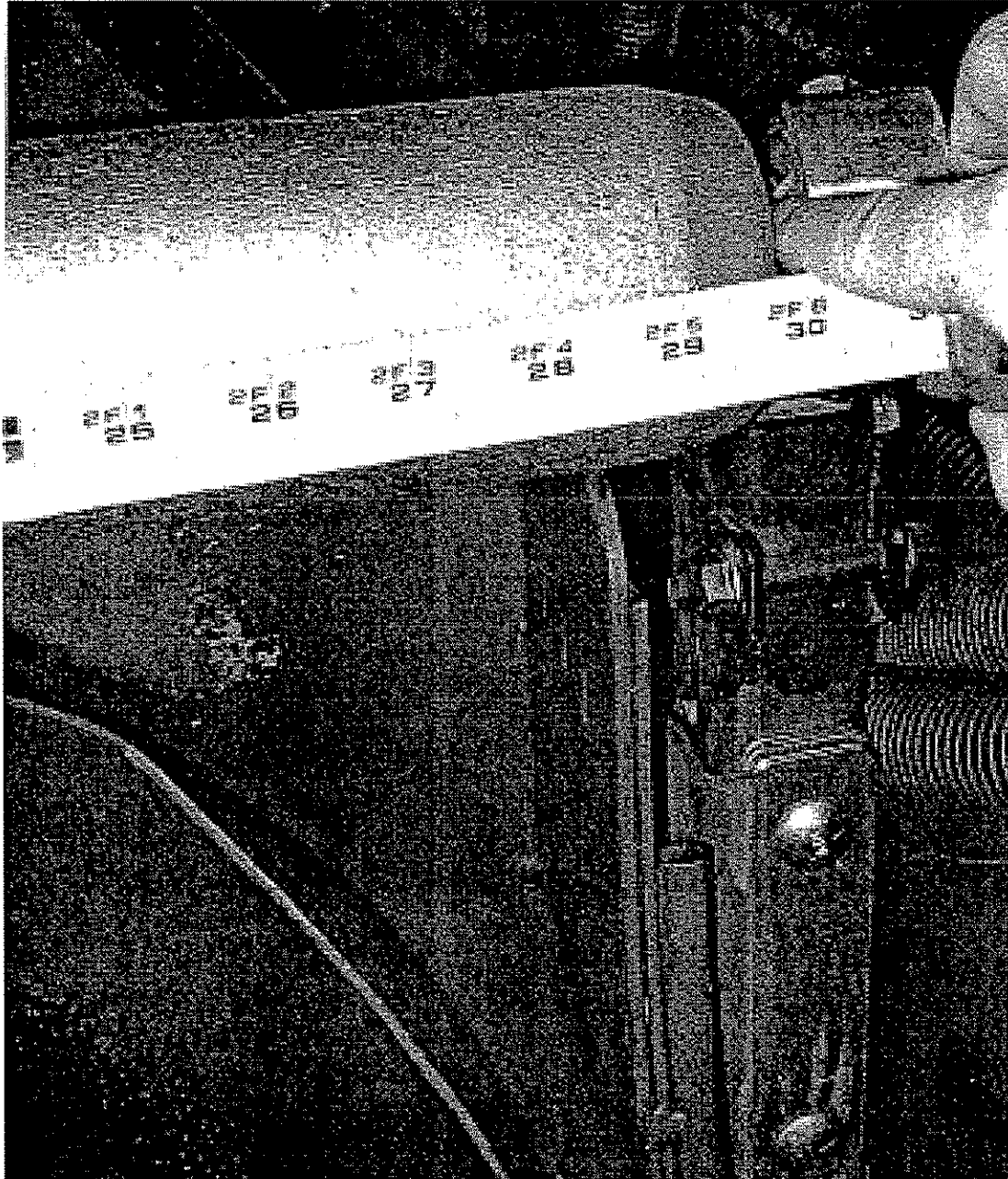
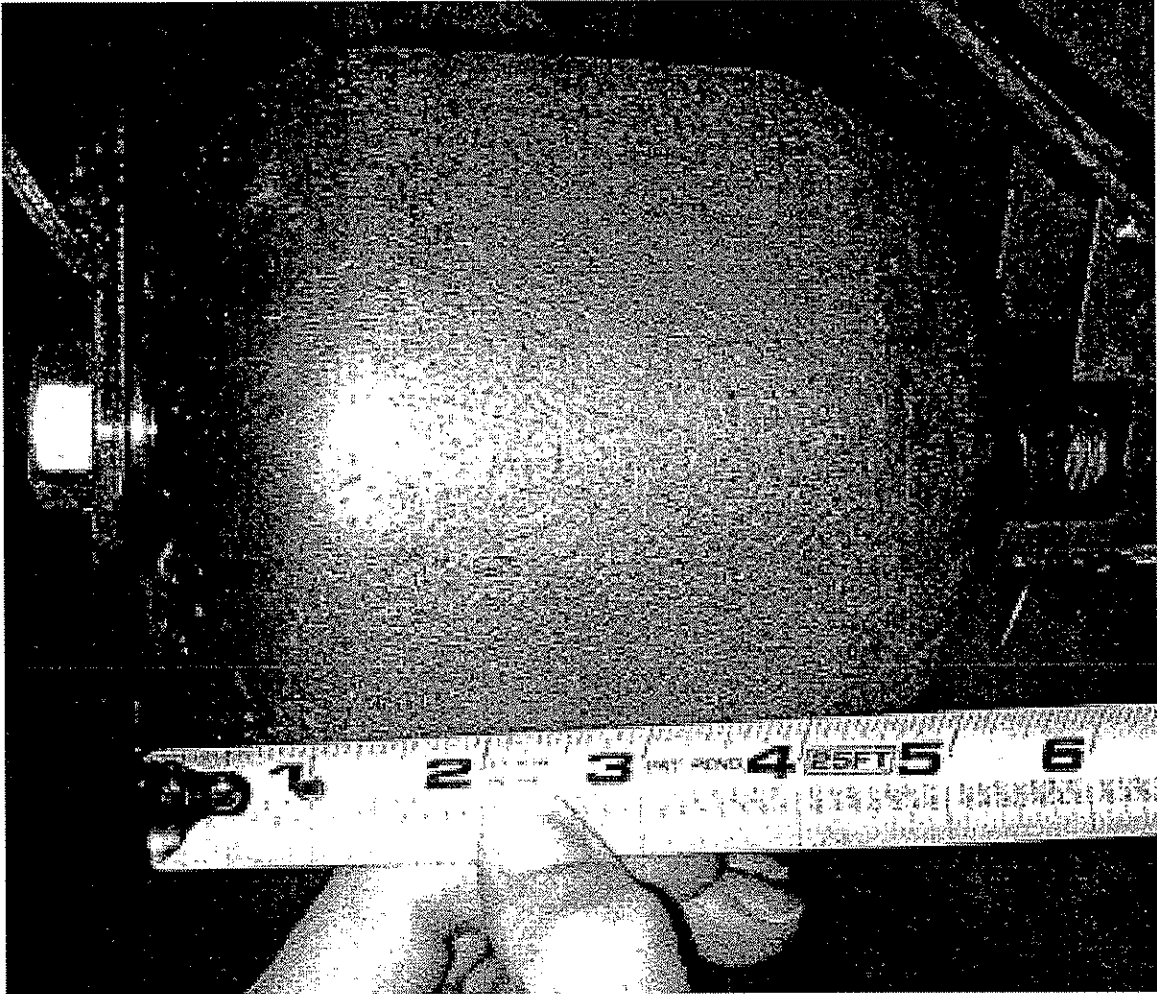


# EXHIBIT A







# EXHIBIT B

LEXSEE 2002 U.S. DIST LEXIS 17783

**TI GROUP AUTOMOTIVE SYSTEMS, (NORTH AMERICA), INC., Plaintiff, v.  
VDO NORTH AMERICA L.L.C. et al., Defendants.**

C.A. No. 00-432-GMS

**UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE**

2002 U.S. Dist. LEXIS 17783

September 4, 2002, Decided

**SUBSEQUENT HISTORY:** Appeal dismissed by *TI Group Auto. Sys. (N. Am.), Inc. v. VDO N. Am. L.L.C.*, 66 Fed. Appx. 868, 2003 U.S. App. LEXIS 11189 (2003) Affirmed by *TI Group Auto. Sys. v. VDO N. Am., L.L.C.*, 2004 U.S. App. LEXIS 13445 (Fed. Cir., June 30, 2004)

**PRIOR HISTORY:** *TI Group Auto. Sys. (N. Am.) v. VDO N. Am. L.L.C.*, 2002 U.S. Dist. LEXIS 4671 (D. Del., Mar. 7, 2002)

**DISPOSITION:** [\*1] VDO's renewed motion for judgment notwithstanding the verdict granted.

**COUNSEL:** For Plaintiff: Douglas E. Whitney, MORRIS, NICHOLS, ARSHT & TUNNELL, Wilmington, Delaware.

For Plaintiff: William J. Schramm, Andrew M. Grove, and Matthew J. Schmidt, Of Counsel, REISING, ETHINGTON, BARNES, KISSELLE, LEARMAN & McCULLOCH, PC, Troy, Michigan.

For Defendants: Arthur G. Connolly, III, CONNOLLY, BOVE, LODGE & HUTZ, LLP, Wilmington, Delaware.

For Defendants: Eric J. Lobenfeld, Drew M. Wintringham III, Keeto H. Sabharwal, Mark W. Rueh, and Ernest Yakob, Of Counsel, CLIFFORD CHANCE ROGERS & WELLS LLP, New York, New York.

**JUDGES:** SLEET, District Judge.

**OPINION BY:** SLEET

**OPINION:**

**MEMORANDUM OPINION**

September 4, 2002

Wilmington, Delaware

**SLEET, District Judge****I. INTRODUCTION**

This action began as a declaratory judgment action initiated by VDO North America, L.L.C., on April 25, 2000 against TI Group Automotive Systems, NA, Inc. ("TI"). The action concerned VDO's alleged infringement of U.S. Patent No. 4,860,714 ("the '714 patent"), which relates to fuel pump assembly [\*2] technology. The parties were realigned on March 7, 2001, thus making TI the plaintiff.

The court held a *Markman* hearing on November 6, 2001 and rendered its claim construction decision on December 3, 2001. On December 17, 2001, TI filed a motion for reconsideration of the claim construction. The court denied this request. Based on the court's claim construction, VDO sought leave to file a motion for summary judgment on non-infringement. Because the dispositive motion deadline had already passed, the court denied this request on February 6, 2002.

A jury trial was held between June 3 and June 11, 2002. During the course of the trial, VDO moved for judgment as a matter of law pursuant to *Rule 50 of the Federal Rules of Civil Procedure* at the close of TI's case-in-chief and again at the close of all evidence. The court reserved judgment on these motions. On June 12, 2002, the jury returned a verdict finding that (1) VDO infringed each of Claims 2, 7, and 8, both literally and under the doctrine of equivalents; (2) Claims 2, 7, and 8 are not invalid; (3) VDO's infringement was willful; (4) the accused Saturn LS-18 fuel pump assemblies are not covered by a license; (5) TI is not entitled [\*3] to lost profits damages with respect to any of the three accused platforms; and (6) TI is entitled to compensatory damages in the form of a reasonable royalty of 5%, or a total of \$ 10,773,492.

Following the jury's verdict, both parties filed post-trial motions. Presently before the court is: (1) VDO's renewed motion for judgment as a matter of law, or alternatively, for a new trial under *Rule 59 of the Federal Rules of Civil Procedure*; (2) TI's motion for prejudgment and post-judgment interest; (3) TI's motion to alter or amend the judgment, or for other related relief; (4) TI's motion for an injunction; and (5) TI's motion for enhanced damages, attorneys' fees, and expenses. The following is the court's decision on all pending post-trial motions.

## II. STANDARD OF REVIEW

Under *Rule 50 of the Federal Rules of Civil Procedure*, a court should grant a motion for judgment as a matter of law only where "there is no legally sufficient basis for a jury to find for [the non-moving] party." *Fed. R. Civ. P. 50*. Thus, in order to prevail on a renewed motion for JMOL following a jury trial, the moving party "must show that the jury's findings, presumed or express, are not supported [\*4] by substantial evidence or, if they were, that the legal conclusions implied [by] the jury's verdict cannot in law be supported by those findings." *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1348 (Fed. Cir. 1998) (quoting *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 893 (Fed. Cir. 1984)). In order to determine whether a legally sufficient basis in fact exists, the trial court must consider all the evidence in a light most favorable to the non-movant, must draw reasonable inferences favorable to the non-movant, must not determine the credibility of witnesses, and must not substitute its choice for that of the jury. See *Odetics, Inc. v. Storage Tech. Corp.*, 185 F.3d 1259, 1269 (Fed. Cir. 1999) (citations omitted). If, after this analysis, substantial evidence exists to support the jury's verdict, then the motion for JMOL must be denied. See *id.*

The essential question in deciding a motion for judgment as a matter of law is whether the evidence the jury could have believed in reaching its verdict was substantial enough to support its findings. See *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1573 (Fed. Cir. 1986). [\*5] Thus, the question is not what the court might have believed, but what the jury could have reasonably determined. See *Dawn Equip. Co. v. Kentucky Farms, Inc.*, 140 F.3d 1009, 1014 (Fed. Cir. 1998) ("the inquiry is whether a reasonable jury, given the record before it viewed as a whole, could have arrived at the conclusion it did.").

## III. DISCUSSION

### A. VDO's Renewed Motion for Judgment as a Matter of Law

VDO moves the court for judgment as a matter of law to reverse the jury's findings that the accused fuel pump assemblies literally infringe the '714 patent, and also infringe the '714 patent under the doctrine of equivalents. Literal infringement of a claim occurs when every limitation recited in a claim appears in the accused device, i.e. when "the properly construed claim reads on the accused device exactly." *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1358 (Fed. Cir. 2000). At trial, TI had the burden of proving literal infringement by a preponderance of the evidence. See *Southwall Technologies, Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1575 (Fed. Cir. 1995).

A device that does not literally infringe a claim [\*6] may nonetheless infringe "if there is equivalence between those elements of the accused product and the claimed elements of the patented invention." *Warner-Jenkins Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 21, 137 L. Ed. 2d 146, 117 S. Ct. 1040 (1997). Infringement under the doctrine of equivalents must be established on a limitation-by-limitation basis. See *id.* at 29 (stating that, "the doctrine of equivalents must be applied to the individual elements of the claim, not to the invention as a whole."). Moreover, the court is mindful that it must take a "special vigilance against allowing the concept of equivalents to eliminate completely" the individual elements of the patented invention. *Id.* at 40.

An element of an accused device is equivalent to an element of the patented invention if the differences between them are insubstantial. *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. at 39; *Zelinski v. Brunswick Corp.*, 185 F.3d 1311, 1316-17 (Fed. Cir. 1999); *Dawn Equip. Co. v. Kentucky Farms Inc.*, 140 F.3d 1009, 1014 (Fed. Cir. 1998). Alternatively, the accused product infringes [\*7] under the doctrine of equivalents if the element in the accused device performs substantially the same function in substantially the same way to obtain the same result as the claim limitation. See *Warner-Jenkinson*, 520 U.S. at 39; *Zelinski v. Brunswick Corp.*, 185 F.3d at 1316-17; *Dawn Equip. Co. v. Kentucky Farms Inc.*, 140 F.3d at 1016. Whether the former, the "insubstantial differences" test, or the latter, the "triple identity" test is applied, the essential inquiry remains the same: "does the accused product or process contain elements identical or equivalent to each claimed element of the patented invention?" *Warner-Jenkinson*, 520 U.S. at 40.

A determination of infringement under the doctrine of equivalents is a factual matter normally reserved for a fact finder. *Sage Products, Inc. v. Devon Indus., Inc.*, 126 F.3d 1420, 1423 (Fed. Cir. 1997). Although infringement under the doctrine of equivalents is generally considered a question of fact, that does not in and of itself preclude directing judgment in favor of the accused in-

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fringer. There is a triable issue of fact only if the evidence is [\*8] such that a reasonable jury could resolve the question in favor of the patentee. *Dawn Equip. Co. v. Kentucky Farms Inc.*, 140 F.3d at 1017 (reversing district court and granting judgment for defendant where devices were not substantially the same) (citing *Warner-Jenkinson*, 520 U.S. 17, 39, n.8, 137 L. Ed. 2d 146, 117 S. Ct. 1040)). Finally, just as with literal infringement, the patentee must prove by a preponderance of the evidence that each element of the patent, or its substantial equivalent, exists in the accused device. See *Lemelson v. United States*, 752 F.2d 1538, 1551 (Fed. Cir. 1985).

With this legal background in mind, the court will now consider the claims at issue in the '714 patent.

### 1. Independent Claim 2 of the '714 Patent

Because the parties dispute whether there is substantial evidence to support the jury's verdict that the accused assemblies infringe Claim 2 of the '714 patent, the court will first set forth Claim 2 in its entirety and will then evaluate the evidence with regard to each disputed term. Claim 2 of the '714 patent reads as follows:

Apparatus for pumping fuel from a fuel tank to an engine comprising: [\*9]

(a) a supply port for carrying fuel from the apparatus to the engine;

(b) a fuel reservoir which includes an opening for connecting the interior of the reservoir to the interior of the fuel tank;

(c) means for mounting the reservoir in the fuel tank so as to locate the opening of the reservoir in the region of the bottom of the fuel tank;

(d) pumping means for pumping fuel into the reservoir, said means being located within the reservoir in the region of the opening and including a nozzle and a venturi tube in alignment with the nozzle, the passage of fuel out of the nozzle and through the venturi tube causing fuel to be entrained through the opening into the interior of the reservoir;

(e) a high pressure pump having an inlet connected the interior of the reservoir and an output of high pressure fuel; and

(f) means for routing a first portion of the output of high pressure fuel to the supply

port and a second portion of the output of high pressure fuel to the pumping means whereby fuel is delivered to the engine from the reservoir through the supply port and fuel is entrained into the reservoir by means of the fuel passing through the pumping means. [\*10] n1

n1 Claims 2(a), (c) and (e) are not at issue. Thus, the court will only discuss the disputed portions of Claims 2(b), (d), and (f).

#### a. "Fuel Reservoir"

In the asserted claim, the fuel is entrained directly into the reservoir through an aperture disposed adjacent to both the interior of the reservoir and the interior of the fuel tank. The fuel is then kept in the reservoir by way of the "check valve 22, which prevents fuel from passing out of the reservoir into the main tank through the ... opening." The court has construed the term "reservoir" in Claim 2 to mean "the portion of the apparatus for pumping fuel in which fuel is collected and retained apart from the fuel in the fuel tank." It further recognized that the reservoir "does not include all things that can house fuel."

At trial, TI's technical expert, Michael Leshner ("Leshner"), testified that the mixing tube of the accused fuel pump assemblies collects and retains fuel apart from the fuel in the fuel tank. See Transcript of Trial, [\*11] ("Tr.") at 1128. Specifically, he opined that this was so because "once [fuel] goes in the opening [the inlet to the mixing tube], since it can't go back, it meets all of the tests for the definition of a reservoir. Once it goes in, it's collected and retained." *Id.* He also testified that, in his opinion, even the tubes leading up to and away from the engine collect and retain fuel, thus making them literally part of the reservoir. See *id.* at 1190-1191.

However, the court has already rejected TI's position. During the *Markman* phase, TI argued that the term "reservoir" should be construed to mean a unit, receptacle, or repository for things or articles. VDO proffered the construction ultimately adopted by the court verbatim. During the *Markman* hearing, TI argued that VDO's construction was too narrow, and that "a broader interpretation of this term is provided by intrinsic evidence." Specifically, TI argued that:

Defendants' unduly narrow definition implicitly defines the boundaries of the reservoir to include the check valve and no portion of the reservoir outside the check

valve. This is true because in Defendants' definition the reservoir is not the unit [\*12] or receptacle itself, but merely the portion that "retains" fuel.

D.I. 84 at 8.

Thus, TI understood that, if the court accepted VDO's construction, the boundaries of the reservoir of Claim 2 could not extend past the check valve. As this would necessarily put the accused mixing tube also outside the reservoir, the tube cannot be part of the reservoir itself. In light of this understanding, it is clear that TI's argument at trial, and in its Answering Brief, are nothing more than arguments about what the term *should* mean, notwithstanding what the court has already said it *does* mean.

To the extent that there was confusion regarding the court's *Markman* ruling at trial, the court directed TI to have its witness testify more consistently with the court's order. Specifically, the court stated that, "[the] definition [of reservoir] being that the can is the thing. The can is-- it is not ... the hoses and doodads and all the things that can house fuel that are the reservoir. It's the can." *Id.* at 437-438. There is thus no basis for TI's assertion that the can may be anything that can contain fuel and is attached to the can.

Moreover, no reasonable jury could have [\*13] found that the accused mixing tube was part of the claimed reservoir because the mixing tube does not collect and retain fuel. TI admits that the fuel is not retained in the mixing tube when the jet pump is not operating and the assembly is subjected to certain conditions, such as when the vehicle is parked on an incline and there is no fuel from the tank in the area of the jet pump. In such situations, any fuel that may have been in the mixing tube leaks back into the fuel tank. TI does, however, contend that: (1) under operating conditions, the accused jet pump keeps fuel in the mixing tube, and (2) under most non-operating conditions, the mixing tube is submerged in fuel and thus collects and retains fuel. The court will discuss each argument in turn.

TI's principal argument is that the jet pump retains fuel in the mixing tube during operation. According to TI, because the jet pump forces fuel in one direction through the mixing tube, past the check valve, and into what VDO submits is the reservoir, that the mixing tube collects and retains fuel. To bolster this argument, TI asserts that the mixing tube "is not one of the hoses and things that the court specifically excluded from [\*14] the definition of reservoir." Even assuming, *arguendo*, that the court were to accept this bare statement, TI ignores the fact that Leshner admitted that his opinion that the mixing tube was part of the reservoir was based on the

same logic he used to opine that all the hoses leading up to, and away from, the engine are part of the reservoir. *See id.* at 1190-1191. Specifically, Leshner testified that the movement of fuel [through a tube or hose] is the process of collecting and retaining fuel. *See id.* at 1187. Because this logic would necessarily encompass hoses and tubes which the court has already made clear are not part of the reservoir, this basis for concluding that the mixing tube is part of the reservoir is untenable.

TI's second argument, that under most non-operating conditions, "fuel in the mixing tube is bounded by plastic walls on all sides except for the opening," also ignores that "the 'reservoir' does not include all things that can house fuel." Moreover, as VDO recognizes, under non-operating conditions, the mixing tube is essentially "a straw submerged in a cup of liquid." To continue briefly with that analogy, there is nothing keeping the liquid in the [\*15] straw, and if one lifts the straw out of the cup, or even holds the cup at an angle, the liquid will leave the straw. Likewise, there is nothing keeping the fuel in the mixing tube. Indeed, during the trial, Leshner himself testified that if one were to lift the assembly out of the fuel tank, any fuel that may have been in the mixing tube would "dribble out" into the fuel tank, while the fuel in the reservoir would stay in the reservoir. *See id.* at 495-496, 1179-1181, 1186-1187. Because there is no dispute that fuel may leak out of the mixing tube and back into the fuel tank, the jury's finding that the mixing tube was part of the reservoir is clearly in contravention of the court's claim construction.

Accordingly, no reasonable jury could have found that the term 'reservoir', as construed by the court, included VDO's mixing tube.

#### **b. "Pumping Means"**

The court construed the "pumping means" of Claim 2 as a means-plus-function limitation, requiring a "connecting tube 164, jet pump 30 formed in jet block 144 and associated check valve 22," or the structural equivalent. VDO does not dispute that the accused assemblies have a flapper valve that keeps fuel in the reservoir, like [\*16] the associated check valve 22. However, VDO maintains that the accused flapper valve is not *associated* with the accused jet pump.

It is clear that both the VDO and the TI systems utilize the action of a jet pump to a certain extent. However, the "pumping means" of Claim 2 must be contained within the reservoir. The action of the jet pump of the "pumping means" entrains fuel *directly* into the reservoir. To keep the fuel in the reservoir, there is an associated check valve 22 in the opening of the reservoir. The associated check valve 22 is lifted during operation of the jet pump because of the low pressure region created around the opening to the reservoir. The fuel being sprayed out

of the jet nozzle simply returns to the reservoir, along with the fuel that has already been entrained into the reservoir. The check valve 22 of the patented fuel pump assembly is associated with the "pumping means" in that it opens and closes by the low pressure region created by the jet pump. Finally, because the "pumping means" is inside the reservoir, that opening allows fuel to be entrained directly into the interior of the reservoir.

In contrast to the fuel pump assembly of Claim 2, the [\*17] jet pump of the accused fuel pump assemblies is outside of the reservoir. Fuel is entrained into the jet pump's mixing tube. The mixing tube mixes entrained fuel with the fuel being sprayed out of the jet nozzle. It is only then that the pressure of the combined fuel pushes through a flapper valve at the end of the mixing tube, ultimately flowing into the reservoir. There is no check valve at the inlet of the mixing tube, *i.e.*, at the opening by the low pressure region created by the jet pump. Accordingly, no reasonable jury could have found literal infringement of this claim term.

Furthermore, the court concludes that no reasonable jury could have found infringement under the doctrine of equivalents. During the trial, the only evidence TI presented with respect to the differences between the flapper valve and the check valve 22 was the following testimony from Leshner:

The thing that has been referred to as the flapper valve or the check valve or the one-way valve, it's the corresponding structure to check valve 22 in the patent. It closes when the pump is off. It opens when the pump is turned on. It does the same thing. So it has--yes, it has an associated check valve [\*18] corresponding to check valve 22.

Tr. at 1139.

Leshner failed to discuss the fact that the flapper valve does not keep fuel from leaving the mixing tube, which, according to TI, is part of the reservoir. However, the patent clearly states that the associated check valve 22 keeps fuel in the reservoir. Moreover, the court has already determined that, under its claim construction, the mixing tube cannot be considered part of the reservoir. Thus, as Leshner failed to discuss the purposes behind the flapper valve and check valve 22, his bald assertion is insufficient to establish equivalence. *See Dawn Equip. Co. v. Kentucky Farms, Inc.*, 140 F.3d 1009, 1017 (Fed. Cir. 1998).

**c. "said [pumping] means being located within the reservoir"**

In its claim construction, the court construed the above disputed term to require that the "pumping means components [be] located inside the reservoir."

VDO asserts that, even assuming *arguendo* that the accused fuel pump assemblies have the claimed "pumping means," no reasonable jury could have determined that they were "located inside the reservoir." Specifically, VDO argues that, each of the components Leshner identified [\*19] as part of the accused "pumping means" is plainly *outside* the reservoir, as construed by the court. The court must agree.

The jet pump of the accused assemblies is indisputably outside the reservoir because it is located at the opposite end of the mixing tube from the flapper valve. n2 Likewise, the accused jet block, which Leshner identified as "the plastic that holds the nozzle in alignment with the mixing tube," is also clearly outside the reservoir. Additionally, with respect to the "connecting tube," Leshner testified that virtually all of the accused "connecting tube" in the VDO assemblies is outside the reservoir. *See* Tr. at 510. Indeed, Leshner's opinion that the accused "connecting tube" is inside the reservoir is based solely on his opinion that two small portions of the tube are allegedly inside the reservoir. *See id.*

n2 Although TI offers statements from VDO's engineers which refer to the jet pump as being "inside the reservoir" and "inside the swirl pot," these statements are irrelevant for purposes of this inquiry as they were made prior to the court's claim construction.

[\*20]

The first portion of the tube at issue that TI contends is inside, is, at most "1 millimeter or 2 millimeters ... below the top portion" of the reservoir, where the tube connects to one of the outlets of the high pressure pump. The portion of the tube inside the reservoir is thus *de minimus* and cannot meet the claim limitation that the tube itself be "inside" the reservoir. The second portion is the connection to the jet nozzle, which, together with the mixing tube, make up the jet pump. As the court has already determined that the jet pump, including the jet nozzle, is not part of the reservoir, the fact that the connecting tube may enter the jet pump is irrelevant. Accordingly, there cannot be literal infringement of this claim term. n3

n3 In its Answering Brief, TI asserts that, because the connecting tube is actually clipped to the outside of the can inside a groove, and the groove "juts into the interior space of the reservoir where the fuel is held," the connecting tube is also inside the reservoir. Because "inside" cannot mean "outside," which includes being clipped to the outside, the court finds this argument untenable.

[\*21]

With regard to the doctrine of equivalents, it is clear that the all-limitations rule precludes a finding of substantial equivalence between "outside" and "inside," as such a finding would vitiate the "inside" limitation. See *Moore U.S.A., Inc. v. Standard Register, Co.*, 229 F.3d 1091 (fed. Cir. 2000), cert. denied, 532 U.S. 1008, 149 L. Ed. 2d 659, 121 S. Ct. 1734 (2001) (stating that, "minority" could not be the substantial equivalent of "majority," because if that were the case, a claim limitation requiring a "majority" would "hardly be necessary."). Thus, the court concludes, as a matter of law, that no reasonably jury could have found infringement of this term under the doctrine of equivalents.

**d. "opening for connecting the interior of the reservoir to the interior of the fuel tank ..."**

The court construed this limitation to mean "an aperture disposed adjacent to both the interior of the reservoir and the interior of the fuel tank, allowing fuel to be entrained directly into the reservoir."

At trial, TI pointed to the inlet of the mixing tube as the claimed "opening." See Tr. at 374, 1172. However, this inlet is not "adjacent to [\*22] the interior of the reservoir." Rather, fuel entering the accused "opening" must travel through the mixing tube before entering the reservoir. Indeed, Leshner himself admitted that, if the reservoir starts at the flapper valve, then the inlet to the mixing tube is not adjacent to the interior of the reservoir. See *id.* at 1171. Because under the court's claim construction, the reservoir must start at the flapper valve, there can be no literal infringement.

Furthermore, for the reasons the court discussed in Section III.A.1.c., *supra*, there can be no infringement under the doctrine of equivalents. Claim 2 explicitly requires that the "opening" of the claim "connect[] the interior of the reservoir to the interior of the fuel tank." Thus, equating the inlet identified by TI with the "opening" of Claim 2 would impermissibly vitiate the limitation.

**e. "causing fuel to be entrained through the opening into the interior of the reservoir ..."**

The court has construed Claim 2 to mean that the "pumping means" cause fuel to be "drawn through the opening into the interior of the reservoir."

VDO argues that, because of the structural differences between the "pumping [\*23] means" of Claim 2 and the jet pump of the accused fuel pump assemblies, fuel is pushed from the jet pump's mixing tube into the reservoir in the accused fuel pump assemblies. It is not entrained, or drawn, as required by the '714 patent and the court's claim construction. TI does not dispute that fuel is not entrained into the reservoir. Rather, Leshner testified that fuel is entrained into the mixing tube. See *id.* at 1140. Moreover, the court has construed "opening" to require entrainment directly into the interior of the reservoir. Thus, because the reservoir, as a matter of law, cannot include the mixing tube of the accused assemblies, no reasonable jury could find that fuel is "entrained through the opening into the interior of the reservoir," let alone directly into the interior of the reservoir.

Furthermore, as with the "inside the reservoir" limitation, the accused "pumping means" cannot be equivalent to the "pumping means" of Claim 2, without vitiating the requirement that the fuel be entrained directly into the interior of the reservoir. Accordingly, there can be no infringement under the doctrine of equivalents.

**f. "means for routing a first portion [\*24] of the output of high pressure fuel to the supply port and a second portion of the output of high pressure fuel to the pumping means ..."**

The court construed the "means for routing" limitation as a means-plus-function limitation pursuant to 35 U.S.C. § 112, P 6. According to the court's claim construction, the recited function in the "means for routing ..." limitation is to "route a first portion of the output of high pressure fuel to the supply port and a second portion of the output of high pressure fuel to the pumping means." Additionally, the court held that the corresponding structure in the patent specification comprises "main housing 140, check valve 38, supply nozzle 134 and the associated structure leading to jet pump 30."

VDO maintains that its fuel pump assemblies do not perform the recited function of the "means for routing" limitation. It further asserts that its assemblies do not have a main housing 140 and check valve 38, which route two portions of a single output of high pressure fuel to two separate locations. Instead, VDO argues that the high pressure pump of its accused fuel pump assemblies has two separate outputs, and thus does not need [\*25] a "means for routing." TI responds that the accused fuel pump assemblies have a single output of high pressure fuel inside the high pressure pump, somewhere between the bottom of the high pressure pump and the top of the high pressure pump. TI additionally argues

that the plastic cap at the top of the pump is the main housing 140, which then separates a single output.

TI's position relies on dissecting a single component, namely the high pressure pump, into separate components to satisfy other claim limitations. According to its reading of Claim 2, the interior of the high pressure pump is also the output of the high pressure pump, and the top of the high pressure pump is the main housing 140. However, this argument must fail for two reasons. It must first fail because a "high pressure pump having ... an output" is specifically recited in subpart (e) of Claim 2, and the "means for routing ..." is a distinct structure recited in subpart (f). VDO's assemblies do not have these separate structures. Second, according to TI's understanding, any supply-side fuel pump assembly necessarily has the claimed means for routing because it would have a high pressure pump which simultaneously pumps [\*26] fuel to the engine and to a jet pump. Based on TI's interpretation, the "means for routing ..." limitation would be rendered redundant and superfluous. This would be in direct contravention to the Federal Circuit authority that, "all the limitations of a claim must be considered meaningful." *Unique Concepts, Inc. v. Brown*, 939 F.2d 1558, 1562 (Fed. Cir. 1991).

The court also notes that TI's arguments are effectively an end-run around the court's rejection of TI's position at the *Markman* hearing that the "means for routing" is broad enough to include any "lines, tubes or hoses that permit fuel flow as described." It is clear that the VDO assemblies simply have a high pressure pump with two outputs, which respectively lead to, in TI's words, two separate "line, tubes or hoses." Applying the court's claim construction to this term then, it is clear that no literal infringement exists.

With regard to infringement under the doctrine of equivalence, TI has presented no evidence that any structure of the accused fuel pump assemblies is equivalent to the specific structural and functional limitations of the "means for routing" limitation. Moreover, there can be no equivalence [\*27] as such a finding would vitiate the entire "means for routing ..." limitation. n4

n4 VDO argues that, notwithstanding the lack of evidence on the doctrine of equivalents, TI is precluded from arguing the doctrine of equivalents due to prosecution history estoppel. However, as the court has concluded that there is no equivalents, it need not reach this issue.

## 2. Dependent Claim 7: "baffle"

Claim 7 depends from Claim 2. In its entirety, Claim 7 reads: "the apparatus of claim 2 wherein the outlet

from the pumping means is separated from the inlet to the high pressure pump by a baffle." The court construed the disputed term "baffle" to mean a "structure for isolating fuel leaving the pumping means from the region of the inlet to the high pressure pump."

In TI's case-in-chief, Leshner's testimony with respect to Claim 7 consisted solely of identifying five different structures, each of which he simply argued "deflected" fuel. n5 TI's rebuttal case focused on only one of the structures originally identified [\*28] by Leshner, namely the ring at the bottom of the high pressure pump. However, the inlet ring is located above where fuel enters the reservoir in the accused assemblies and above where the fuel enters the high pressure pump. The ring's purpose is to connect the filter to the inlet of the high pressure pump. See Tr. at 1158. Indeed, Leshner testified that the filter is where the fuel enters the high pressure pump. See *id.* at 1159. Because the fuel enters through the filter, and the ring is above the filter, the ring cannot possibly isolate fuel.

n5 To avoid possible juror confusion, the court instructed the jury that "deflecting is not the same as isolating." Jury Instructions, § 3.1.1, P 7.

For essentially the same reasons that there is no literal infringement, there can be no infringement under the doctrine of equivalents. There is simply no structure in the accused fuel pump assemblies that isolates turbulent fuel from the inlet to the high pressure pump. n6 Because the accused fuel pump assemblies [\*29] entrain fuel outside of the reservoir, there is no need to worry about turbulence at the region of the inlet to the high pressure fuel pump. Thus, there is no structure, because none is needed, that performs the function of the baffle in Claim 7.

n6 The '714 patent explicitly recites the function of the baffle: "as shown in FIG. 9, jet block 144 includes baffles 172 whereby the fuel leaving the jet pump is isolated from the region of the opening 154 which receives inlet 42 to high pressure pump 26 ... the inlet to the high pressure pump sits in a relatively calm pool of fuel and is unaffected by the turbulence and, in some cases, frothing which results from the operation of the jet pump when entraining air."

## 3. Dependant Claim 8: "opening at the bottom of the reservoir."

2002 U.S. Dist. LEXIS 17783, \*

Claim 8 also depends from Claim 2. In relevant part, Claim 8 requires that the "opening is located at the bottom of the reservoir." The court construed this limitation to mean that "the opening [of Claim 2] is formed in the bottom surface [\*30] of the reservoir." Thus, not only must the "opening" of Claim 8 be an "aperture connecting the interior of the reservoir to the interior of the fuel tank," it must also be "formed in the bottom surface of the reservoir."

As the court discussed above in Section III.A.1., the accused fuel pump assemblies do not have an "aperture connecting the interior of the reservoir to the interior of the fuel tank." Because the accused fuel pump assemblies do not have this "opening," it follows that the accused assemblies do not have an "opening that is "located in the bottom of the reservoir." Furthermore, the inlet to the mixing tube, which TI contends is the "opening" of Claim 2, is clearly not "formed in the bottom surface of the reservoir." Rather, it is formed in the wall of a structure, *i.e.*, the mixing tube, which is located outside of the reservoir.

Finally, there can be no equivalence with respect to Claim 8 for all the reasons that there can be no equivalence with respect to the "opening" limitation of Claim 2. If there is no "opening," it cannot be in the bottom surface of the reservoir.

Accordingly, because the court has found that no reasonable jury could have found literal infringement, [\*31] or infringement under the doctrine of equivalents,

it will grant VDO's renewed motion for judgment notwithstanding the verdict. n7

n7 VDO also contends that, in the event that the court concludes that a reasonable jury could have found infringement, the court should also find that: (1) the patent was invalid for obviousness, (2) the infringement was not willful, and (3) VDO had a license to produce the accused Saturn LS-18 fuel pump assemblies. However, as the court has determined that VDO's accused fuel pump assemblies did not infringe the '714 patent, the court need not address these issues.

#### **B. TI's Post-Trial Motions**

TI's post-trial motions are all premised on the jury's verdict being upheld. However, because the court has concluded that the jury's infringement verdict was incorrect as a matter of law, these motions are now rendered moot. Accordingly, the court will not address them.

#### **V. CONCLUSION**

Applying the court's claim construction order, no reasonable jury could have found that VDO's [\*32] accused assemblies literally infringed the '714 patent, nor could a reasonable jury have found infringement under the doctrine of equivalents. The court will issue an order in conjunction with this opinion.

# EXHIBIT C

Nov-04-99 03:58pm From:MICHAEL BEST  
Rev-04-99 02:18pm P/CM:WILKALL

T-140 P.08/11 F-859

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
Group Art Unit 3616

11/17/99

In re

Patent Application of

Richard D. Bednar

Serial No. 08/794,141

Filed: February 3, 1997

Examiner: Petruto, R.

GANG-TYPE ROTARY LAWN MOWER

I, Mary K. Vuk, hereby certify that this correspondence is being sent by facsimile transmission addressed to Assistant Commissioner for Patents, Washington, D.C. 20231, on the date of my signature.

Mary K. Vuk  
Signature  
November 4, 1999  
Date of Signature

Assistant Commissioner for Patents  
Washington, D.C. 20231

DECLARATION UNDER RULE 132

I, Richard D. Bednar, do hereby declare that:

1. I am an adult citizen of the United States, residing in Lake Mills, Wisconsin.
2. I am the inventor of the invention claimed in the above-referenced patent application (hereinafter the "Gang-type Rotary Mower").
3. As one skilled in the art of mowers and their design and construction, I conclude that my invention would not have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. My invention provides a unique solution to a long-term mower problem, as described herein. With the extensive knowledge base in the mower industry of mowers and their shortcomings, my invention would have been made long ago if it had been obvious. In fact, conventional wisdom, as described herein, steered manufacturers away from my invention as a solution to existing problems with mowers.
4. I am told that some of the claims of my patent application have been rejected as being obvious based on a combination of features found in a number of patent applications.

JA - 0150

Nov-04-98 03:58pm From:MICHAEL BEST  
 Nov-04-98 02:18pm From:MICHAEL :

T-140 P.07/11 F-859

and a publication. With the vast number of mower designs and mower manufacturers in the industry, any obvious combination of features that might give a company a competitive edge has likely been tried. Rotary mowers have typically not been used to cut golf course roughs, which require close trimming and the ability to cut undulating terrain at a relatively short length, because nobody prior to me has recognized the desirability of using, or figured out how to use, gang-type rotary mowers to cut golf course roughs. Conventional wisdom in the art of gang-type mowers held that rotary mowers could not be used to cut golf course roughs. My invention of individual cutting units with the addition of rear rollers, however, made the use of gang-type rotary mowers possible to cut golf course roughs. To the best of my knowledge, gang-type rotary mowers have never had such rear rollers.

5. My Gang-type Rotary Mower invention, which was unknown in the industry only a few years ago, is now worth millions of dollars in annual sales to my company and to the companies that copied my invention.

6. For many years, the mower industry had unsuccessfully sought a solution to the problem of scalping grass while mowing over undulating terrain. Previous rotary mowers are ineffective in compensating for elevation changes in the turf being mowed, resulting in uneven cut heights. This is particularly problematic when the turf is cut at or below ground level, leaving barren spots.

7. My invention provides a solution to that problem by teaching an apparatus with excellent ground-following and anti-scalp characteristics.

8. The effectiveness of my invention as a solution to this long-term problem is evidenced by the extraordinary commercial success of my invention. Annual sales of my company's previous gang-type mower averaged approximately \$4.5 million over the years 1995 to 1997, with no significant increases or decreases from year to year. Our new model embodying my invention was introduced in 1997. The addition of my invention was the only significant change from the prior model. Sales of the new model totaled \$1.3 million in 1997, jumped to \$8.5 million in 1998, and are projected to be \$10 million in 1999. The addition of my invention has more than doubled our mower sales, as compared to our previous model. Because market demand for gang-type mowers remained relatively constant between 1997

No--04-80 03:58pm From:MICHAEL BEST  
 No--04-80 02:15pm From:MICHAEL B

T-140 P.08/11 F-858  
 11-140 F-100 F-100

and 1999, the doubling of our mower sales and the nearly tenfold increase in sales of the new model itself can only be attributed to the addition of my invention to my company's mowers.

9. The effectiveness of my invention as a solution to the long-term problem previously described is also evidenced by the prompt copying of my invention by competitors. Following public disclosure of my invention in 1997, at least two major competing mower manufacturers, Nunez and Toro, realized the efficacy of my solution to the problem. These two companies copied my invention by altering their previous designs to produce and market mowers embodying my invention. These two companies now enjoy significant sales of the models incorporating my invention.

10. I enclose as Appendix A a copy of a Toro advertisement from 1999 highlighting a gang-type single-spindle rotary mower in which the mower decks include rear rollers. These Toro units were new in 1999 and were not previously available.

11. I enclose as Appendix B copies of Nunez advertisements from 1999 highlighting gang-type single-spindle rotary mowers, including rear rollers, as replacements for Toro and John Deere units. These Nunez replacement units were new in 1999 and were not previously available.

12. I understand the scope of pending Claim 1 of my application and conclude that Claim 1 covers the features of my invention that have resulted in the mower's commercial success and copying by competitors. In other words, it is the invention as claimed that produced the mower's success and copying.

13. I believe that the success of the Gang-type Rotary Mower embodying my invention demonstrates that this Gang-type Rotary Mower fulfills a long-felt need for a solution to the problems encountered in mowing undulating terrain. The substantial recent sales of the Gang-type Rotary Mower and the prompt copying by competitors indicate that consumers and the mower industry, respectively, see my Gang-type Rotary Mower as a previously-unknown solution to their mowing problems.

14. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so

Nov-04-99 03:50pm From-MICHAEL BES

T-140 P.00/11 F-859

made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

  
Richard D. Bednar

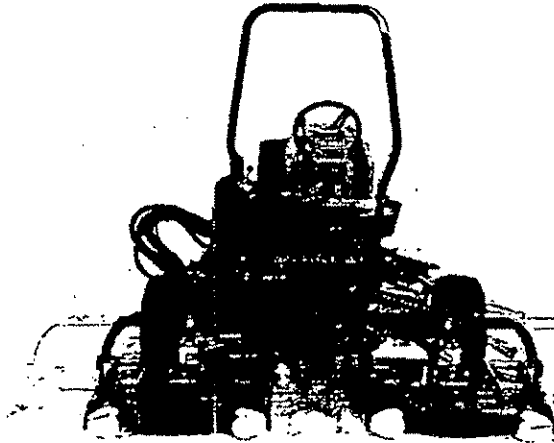
11-4-99  
Date

No. 04-99 04:00pm From: MICHAEL BES\*

T-140 P.10/11 F-259

APPENDIX A

## Groundsmaster® with Contour™ 66 Deck



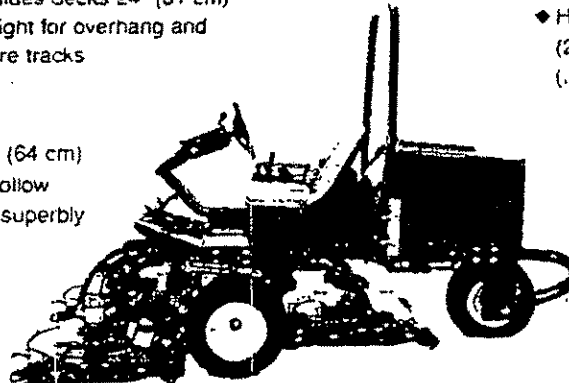
- ◆ Patent pending Sidewinder™ system slides decks 24" (61 cm) left and right for overhang and varying tire tracks

- ◆ Powerful 35 hp Kubota Turbo Diesel

- ◆ HOC range of 1"-4" (2.5-10 cm) in 1/4" (.64 cm) increments

- ◆ 3 full floating 25" (64 cm) mulching decks follow ground contours superbly

- ◆ 66" (168 cm) width of cut



- ◆ Rear rollers provide attractive striping

- ◆ Patented Series/Parallel 3-wheel drive traction minimizes spin-outs

Specifications and design subject to change without notice.  
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Part No. 99-413



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Product  
Preview

JA - 0154

Nov-04-99 04:50pm From:MICHAEL BEF.

T-140 P.11/11 F-859

APPENDIX B



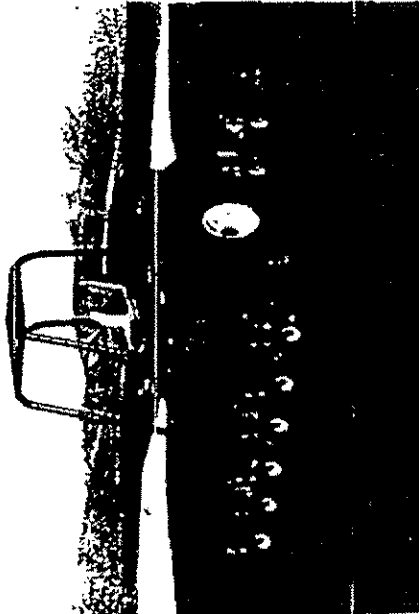
Nunes Manufacturing is proud to introduce to you the newest hydraulic rotary mower with 22 1/2" decks for the John Deere Model 3235A. The mower can be mounted in place of the reel mower with no modification to the power unit. Each deck has one high efficiency hydraulic motor, with special bearings to provide excellent support for blades. For more information please call our sales department and they will be happy to answer any questions.

1707 Magnolia Ave  
Patterson, CA 95363  
(209) 892-8773 or  
Fax (209) 892-5627



*Introducing the newest rotary mowers equipment on wheels*

"Specializing in adapting rotary mowers to fit most traction units."



Nunes Manufacturing is proud to introduce to you our newest hydraulic rotary mower with 22 1/2" decks for the Toro Model 6700 or the Toro Model 6700. The mower can be mounted in place of the reel mower with no modification to the power unit. Each deck has one high efficiency hydraulic motor, with special bearings to provide excellent support for blades. For more information please call our sales department and they will be happy to answer any questions.

1707 Magnolia Ave  
Patterson, CA 95363  
(209) 892-8773 or  
Fax (209) 892-5627



*Introducing the newest rotary mowers equipment on wheels*

"Specializing in adapting rotary mowers to fit most traction units."

# EXHIBIT D

Knurr, Randal S.

11/15/2006

Page 254

1 Q Yes.  
 2 A Yes.  
 3 Q All right. And still with Figure 12, the notion of  
 4 putting the single rear deck assembly between the  
 5 front tires, again, new as to the '312 patent  
 6 relative to the first two patents, correct?  
 7 A Yes.  
 8 Q All right. Figure 13, please. Was this cutting  
 9 deck assembly commercialized?  
 10 A I don't believe so.  
 11 Q Okay.  
 12 A Based on looking at what they did develop, I can't  
 13 tell -- Oh, well, from the -- from what we looked  
 14 at in the manual, it was not a segmented roller.  
 15 Q Would you characterize the rollers 236 on shaft 238  
 16 as a segmented roller in Figure 13? Is that what  
 17 you're trying to illustrate?  
 18 A It's -- Yeah, 36, 30 -- Yeah. Oh, 36 is its  
 19 segmented roller, yeah.  
 20 Q 236?  
 21 A Excuse me. 236, yes.  
 22 Q Okay. As far as you're aware, you never  
 23 commercialized a segmented roller like shown in  
 24 Figure 13?  
 25 A Not -- Not with this product. Again, the only

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1 product other than the AR-250 and the 2500 is this  
 2 one, the AR-5 and 3, or whatever.  
 3 Q All right. And why don't you go ahead and turn to  
 4 the text portion of the '312 patent, please. And I  
 5 want to -- I want to direct your attention to the  
 6 description concerning Figure 13, which is the one  
 7 we were just looking at.  
 8 A Okay.  
 9 Q The description is at Column 6. Line 66 it starts.  
 10 First off, do you see where that begins?  
 11 A "Another cutting deck"?  
 12 Q Yeah.  
 13 A Um-hum.  
 14 Q And your patent is referring to Figure 13 inclusive  
 15 of the rear roller, the caster wheels and the deck  
 16 as a cutting deck assembly 234, correct?  
 17 A Correct.  
 18 Q All right. And, again, you had an opportunity to  
 19 change any inaccuracies in this application, didn't  
 20 you?  
 21 A I would assume so, but we leave that up to the  
 22 patent attorney, to write it properly.  
 23 Q But nevertheless, you didn't have him change the  
 24 description of a cutting deck assembly to refer to  
 25 just the cutting deck, did you?

Page 256

1 A Obviously not.  
 2 Q All right. If you turn to the top of Column 7, at  
 3 about Line 5 -- I'll read it. It says, "Rollers  
 4 236 are preferably axially spaced apart a  
 5 predetermined distance along axle 238 to provide an  
 6 alternate striping effect." Did I read that  
 7 correctly?  
 8 A Yes, that's what it says.  
 9 Q Stop there. What would be the alternate striping  
 10 effect caused by the rollers 236?  
 11 A Well, what -- if I remember right, what we had is  
 12 when you were in -- in the lighter or damp young  
 13 grass, the rollers were really a detriment, because  
 14 they laid the grass down, and it stayed down. So  
 15 part of segmented rollers were to try to eliminate  
 16 some of that, and it was leaving some of it so it  
 17 wasn't laid down.  
 18 Q Okay.  
 19 A But we still needed something to support the deck,  
 20 so that's -- that's what we were trying.  
 21 Q Okay. And so these partial width rollers were used  
 22 to break up, if you will, the single continuous  
 23 roller that was disclosed in Mr. Bednar's original  
 24 application?  
 25 A Yes.

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1 Q All right. And then the next sentence, continuing  
 2 in Paragraph 7, it says, "It should be appreciated  
 3 that rollers 236 are positioned such that they do  
 4 not extend substantially across the entire width of  
 5 mower deck 245." Did I read that correctly?  
 6 A Um-hum.  
 7 Q Okay. And what are you describing there?  
 8 A Again, from, of course, what I can go through,  
 9 because I've read through this to try to understand  
 10 it again -- From what I can recall, is we were just  
 11 trying to cover the bases, that doesn't have to be  
 12 a full-width roller set to be covered in the  
 13 patent, but it's with segmented rollers, is where  
 14 it's covering it.  
 15 Q Okay. So the partial-width rollers that were newly  
 16 added to your application do not extend  
 17 substantially across the entire width of the deck;  
 18 is that fair?  
 19 A In this figure, yes.  
 20 Q Okay. Let's go on to Claim 1 over in Column 8.  
 21 Are you with me there?  
 22 A Yep.  
 23 Q All right. It begins, "A gang type rotary lawn  
 24 mower comprising a frame supported by front wheels  
 25 and at least one rear wheel for movement over the

65 (Pages 254 to 257)

Knurr, Randal S.

11/15/2006

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1 A 260 would be partial. Yeah, they would all be  
 2 partial.  
 3 Q Okay.  
 4 A And 260 as well on Figure 15. Figure 14, 246 is  
 5 partial.  
 6 Q Are there any rollers in the new material that was  
 7 added, Figures 7 through 24, that you would  
 8 characterize as not --  
 9 A Partial?  
 10 Q -- partial width?  
 11 A 11 -- I believe the --  
 12 MR. CAMPBELL: Object, it calls for a  
 13 legal conclusion. You can answer.  
 14 THE WITNESS: Okay. The Figure 11 is  
 15 basically substantially covering all the way across  
 16 with partial rollers, segmented rollers. And then  
 17 we have the cutting width covered in 7 -- 15 and 17  
 18 it's covered, but it's with not a continuous  
 19 roller. Covers the cutting width substantially.  
 20 BY MR. ZEULI:  
 21 Q Okay. Again, just staying with 15 for a minute,  
 22 the -- the cutting width -- in other words, the  
 23 rollers -- Hang on a second. Now, 252, those are  
 24 wheels, correct, in Figure 15?  
 25 A 252?

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1 Q Yeah.  
 2 A Umm --  
 3 Q Look at Column 7.  
 4 A Again, yeah, call them gauge wheels, rollers,  
 5 whatever.  
 6 Q Okay. But if you go to Column 7 --  
 7 A 252, is that what it's calling it?  
 8 Q It's calling it rear wheels.  
 9 A Okay. That's what it says there, yes.  
 10 Q And you didn't correct the patent attorney and say,  
 11 "Ahh, what I meant was roller or gauge wheel,"  
 12 correct?  
 13 A That's what it says here.  
 14 Q All right. So with those being wheels, 252, would  
 15 you characterize 260 as a partial-width roller, or  
 16 something else?  
 17 A Partial-width.  
 18 Q All right. So I guess I go back to 11. Let's look  
 19 at Figure 11. I think you identified that as  
 20 substantially across the width of the roller; is  
 21 that right?  
 22 MR. CAMPBELL: Object to the form of the  
 23 question.  
 24 BY MR. ZEULI:  
 25 Q Yeah, I -- And I apologize. I forgot what you had

Page 264

1 said. But isn't -- isn't the case with respect to  
 2 Figure 11, you have a rearmost roller made up of  
 3 four segmented roller parts, 200A, B, C and D --  
 4 A Um-hum.  
 5 Q -- correct? And that's individually or as a whole  
 6 a partial-width roller, correct?  
 7 MR. CAMPBELL: Object to the form of the  
 8 question.  
 9 THE WITNESS: As it's shown, yes.  
 10 BY MR. ZEULI:  
 11 Q And then it combines, if I'm understanding this,  
 12 with rollers 202 and 204, correct?  
 13 MR. CAMPBELL: Object to the form of the  
 14 question.  
 15 THE WITNESS: To cover the cutting width.  
 16 BY MR. ZEULI:  
 17 Q Yeah. And would you say in that case the  
 18 combination of 202, 200A through D, and 204 covers  
 19 the entire cutting width, or not? Actually, maybe  
 20 the better question is does 202, 200A through D,  
 21 and 204 extend substantially across the entire  
 22 width of the deck?  
 23 MR. CAMPBELL: Calls for a legal  
 24 conclusion.  
 25 THE WITNESS: I guess I can see what I

Page 265

1 see here, it goes up to that frame member, and as  
 2 the -- as the drawing shows --  
 3 BY MR. ZEULI:  
 4 Q Because, I guess, the overall width of the outer  
 5 diameter of the stripe would be 206 on Figure 11;  
 6 is that right?  
 7 A On Figure 11, the outside you say is 206?  
 8 Q Yeah, is that right? The outside dimension of the  
 9 combined segmented roller?  
 10 A That's showing, yes, the substantially full-width  
 11 roll, 206.  
 12 Q Okay. Let me make sure I have got this right.  
 13 A Which the blade within side of the deck is actually  
 14 smaller than the -- within the deck shroud is  
 15 smaller than the shroud itself.  
 16 Q So what you were adding that was new in your patent  
 17 application, compared to what was previously  
 18 disclosed in Mr. Bednar's individual patents, was a  
 19 partial-width roller, correct?  
 20 A Yes.  
 21 Q A three-wheeled tractor?  
 22 MR. CAMPBELL: I'm going to object as  
 23 calling for a legal conclusion. You can answer.  
 24 THE WITNESS: Correct, yes.  
 25 BY MR. ZEULI:

67 (Pages 262 to 265)

Knurr, Randal S.

11/15/2006

Page 266

1 Q A segmented roller, meaning a roller having two --  
 2 well, a segmented roller, I guess?  
 3 MR. CAMPBELL: Same objection.  
 4 THE WITNESS: Yes.  
 5 BY MR. ZEULI:  
 6 Q And then a roller that was in offset relationship?  
 7 In other words, not all of the roller or roller  
 8 parts were in axial alignment?  
 9 MR. CAMPBELL: Same objection.  
 10 THE WITNESS: Correct.  
 11 BY MR. ZEULI:  
 12 Q Why don't we take a -- Here it is. Here it is.  
 13 Take that back. Excuse me.  
 14 Did you ever see an AR-250 without caster  
 15 wheels on the front cutting deck assemblies?  
 16 A Without caster wheels?  
 17 Q Yeah.  
 18 A Like I said before, honestly, we put rear decks on  
 19 the front, and they were not castered.  
 20 Q Sorry. I meant a commercialized version of the  
 21 AR-250 with noncaster-wheeled front deck  
 22 assemblies.  
 23 A Not that I recall.  
 24 Q Okay. And I guess you are not aware of who made  
 25 the change from side plates to a deck frame?

Page 267

1 A Oh, you mean on the Jacobsen?  
 2 Q AR-5 and 3?  
 3 A I don't know who ended up working on it after I  
 4 left.  
 5 Q Okay. But you had not conceptualized the use of a  
 6 deck frame prior to when you left Jacobsen; is that  
 7 fair?  
 8 A S deck frame?  
 9 Q Yeah.  
 10 A A deck frame is on --  
 11 MR. CAMPBELL: I'm going to object to the  
 12 form of the question.  
 13 THE WITNESS: Yeah, I guess what you said  
 14 earlier, the deck frame -- This is a different deck  
 15 frame than what we had on the other one.  
 16 BY MR. ZEULI:  
 17 Q I mean, you had not conceptualized a deck frame  
 18 that didn't include side plates prior to leaving  
 19 Jacobsen; is that correct?  
 20 MR. CAMPBELL: I'm going to object to the  
 21 form of the question.  
 22 THE WITNESS: The one that I put together  
 23 for concepting on the tractor at Jacobsen, it was  
 24 not -- of course, not plates, they were formed,  
 25 with the offsets for the roller and everything

Page 268

1 else -- they were formed side members, and what I  
 2 can see here is they used tubing to make those side  
 3 members, of the frame for the deck. So did I --  
 4 BY MR. ZEULI:  
 5 Q Yeah, you didn't come up with the idea of using  
 6 tubing, correct?  
 7 A Not to use tubing, yes.  
 8 Q Let me ask you if you recall the following problems  
 9 associated with the AR-250. The uncut strips of  
 10 grass?  
 11 MR. CAMPBELL: Asked and answered.  
 12 THE WITNESS: Yes.  
 13 BY MR. ZEULI:  
 14 Q A side hill problem?  
 15 MR. CAMPBELL: Foundation.  
 16 THE WITNESS: Side hill problem? Not  
 17 sure what that means.  
 18 BY MR. ZEULI:  
 19 Q Okay. Were you aware of a thin air problem with  
 20 the AR-250?  
 21 A Thin air?  
 22 Q (Nods head.)  
 23 A Meaning needed the turbo to go to high altitude?  
 24 Q (Nods head.)  
 25 A Yes.

Page 269

1 Q Were you aware of a blowdown problem with the  
 2 AR-250?  
 3 MR. CAMPBELL: Foundation.  
 4 THE WITNESS: Blowdown.  
 5 BY MR. ZEULI:  
 6 Q I believe it referred to blowing down of the grass  
 7 away from the cutter.  
 8 A Am I aware -- as being a problem --  
 9 MR. CAMPBELL: I'm going to object to the  
 10 form of the question as well as assuming facts that  
 11 haven't been established.  
 12 THE WITNESS: Answer, or no?  
 13 MR. CAMPBELL: Yeah, you can answer,  
 14 sure.  
 15 THE WITNESS: Okay. It's the same issue  
 16 in all mulching decks.  
 17 BY MR. ZEULI:  
 18 Q And the AR-250 had the mulching deck?  
 19 A Had the mulching deck set, yes.  
 20 Q Were you aware of an overheating problem with the  
 21 AR-250?  
 22 MR. CAMPBELL: Same objection, assumes  
 23 facts that haven't been established and it  
 24 mischaracterizes the prior testimony in this case.  
 25 THE WITNESS: Again, we put a bigger

68 (Pages 266 to 269)

# EXHIBIT E

US005280695A

**United States Patent** [19][11] **Patent Number:** 5,280,695

Nunes, Jr. et al.

[45] **Date of Patent:** Jan. 25, 1994[54] **WIDE AREA LAWNMOWER**

[75] **Inventors:** John F. Nunes, Jr., Modesto; Aaron M. Days, Turlock; Gilbert W. Borba; Manuel Furtado, Jr., both of Patterson, all of Calif.

[73] **Assignee:** Nunes Manufacturing, Inc., Patterson, Calif.

[21] **Appl. No.:** 832,858

[22] **Filed:** Feb. 7, 1992

[51] **Int. Cl.<sup>5</sup>** ..... A01D 75/30

[52] **U.S. Cl.** ..... 56/6; 56/13.5; 56/15.2; 56/DIG. 9; 56/DIG. 14

[58] **Field of Search** ..... 56/6, 13.5, 13.7, 15.2, 56/15.8, 16.9, DIG. 9, DIG. 14

[56] **References Cited****U.S. PATENT DOCUMENTS**

2,830,421	4/1958	Blue et al.	56/6
3,058,280	10/1962	Lewis	56/6
4,697,404	10/1987	Brockmeier et al.	56/6
4,854,112	8/1989	Holley et al.	56/6
5,069,022	12/1991	Vandermark	56/6
5,133,174	7/1992	Parsons, Jr.	56/15.2 X

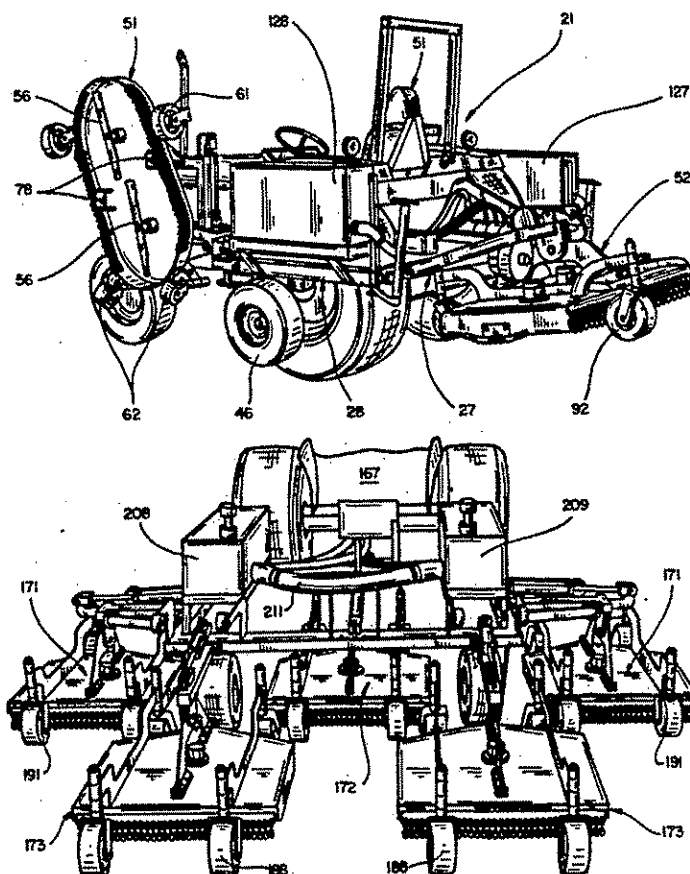
*Attorney, Agent, or Firm*—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

Wide area mower which can be attached to and detached from a tractor in a relatively short time. In one disclosed embodiment, the mower has a main frame which is detachably connected to the rear mount of a tractor, swing frames pivotally connected to the main frame for movement into and out of engagement with the side mounts of the tractor, means detachably locking the swing frames in engagement with the side mounts, and mowing heads mounted on the frames to the sides and rear of the tractor. In another disclosed embodiment, the mower includes a frame adapted for connection to a towing vehicle, a pair of side decks positioned on opposite sides of the frame, a center deck positioned between the side decks, a pair of rear decks positioned to the rear of and between the side decks and the center deck. Ground engaging wheels at the front and rear of each deck support the decks, with the wheels at the rear of the side decks and the center deck being aligned with the wheels at the front of the rear decks, and means pivotally mounting the decks to the frame so that the decks can follow the contour of the ground.

*Primary Examiner*—Terry Lee Melius

**23 Claims, 20 Drawing Sheets**



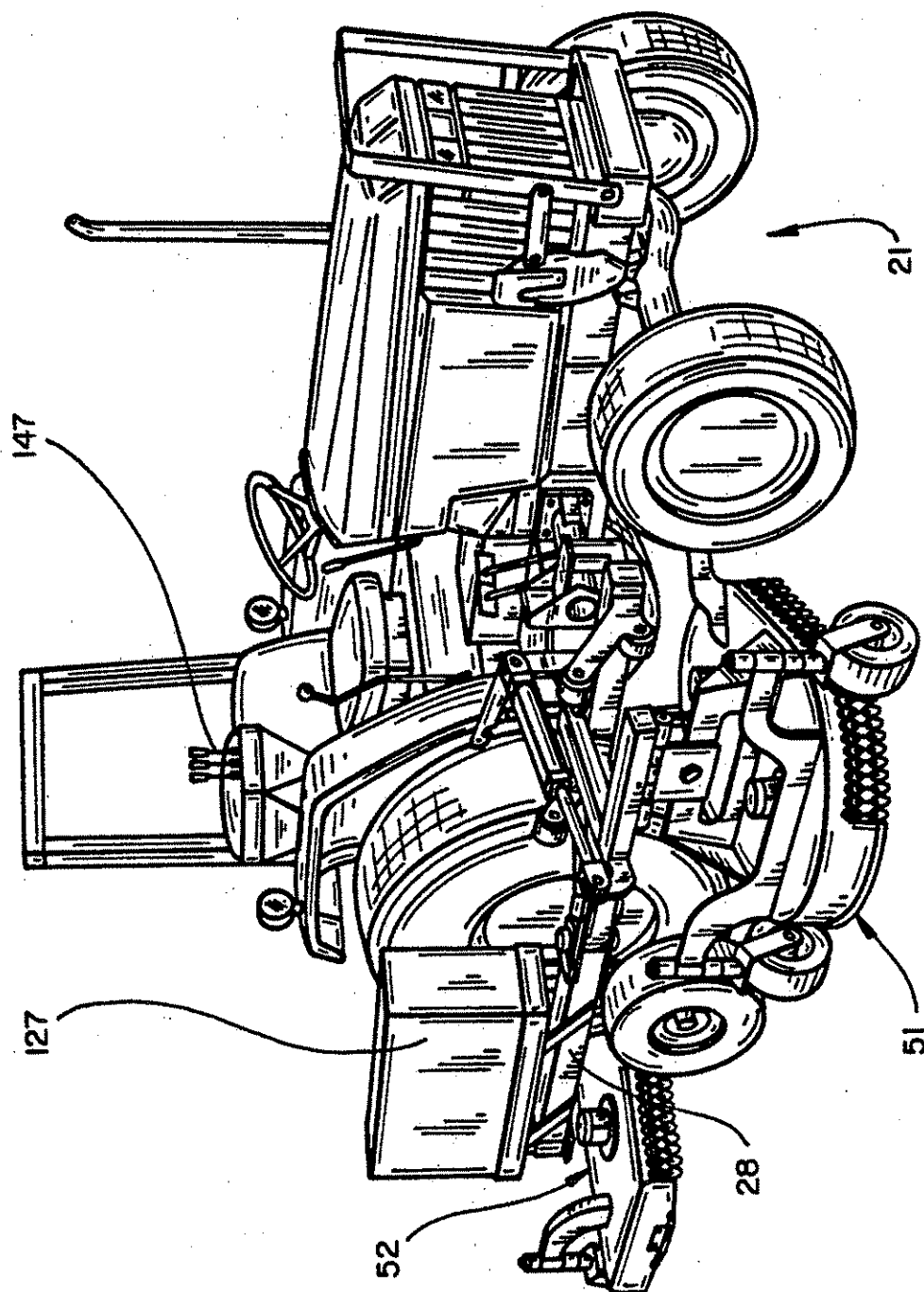


FIG 1



**FIG-2**

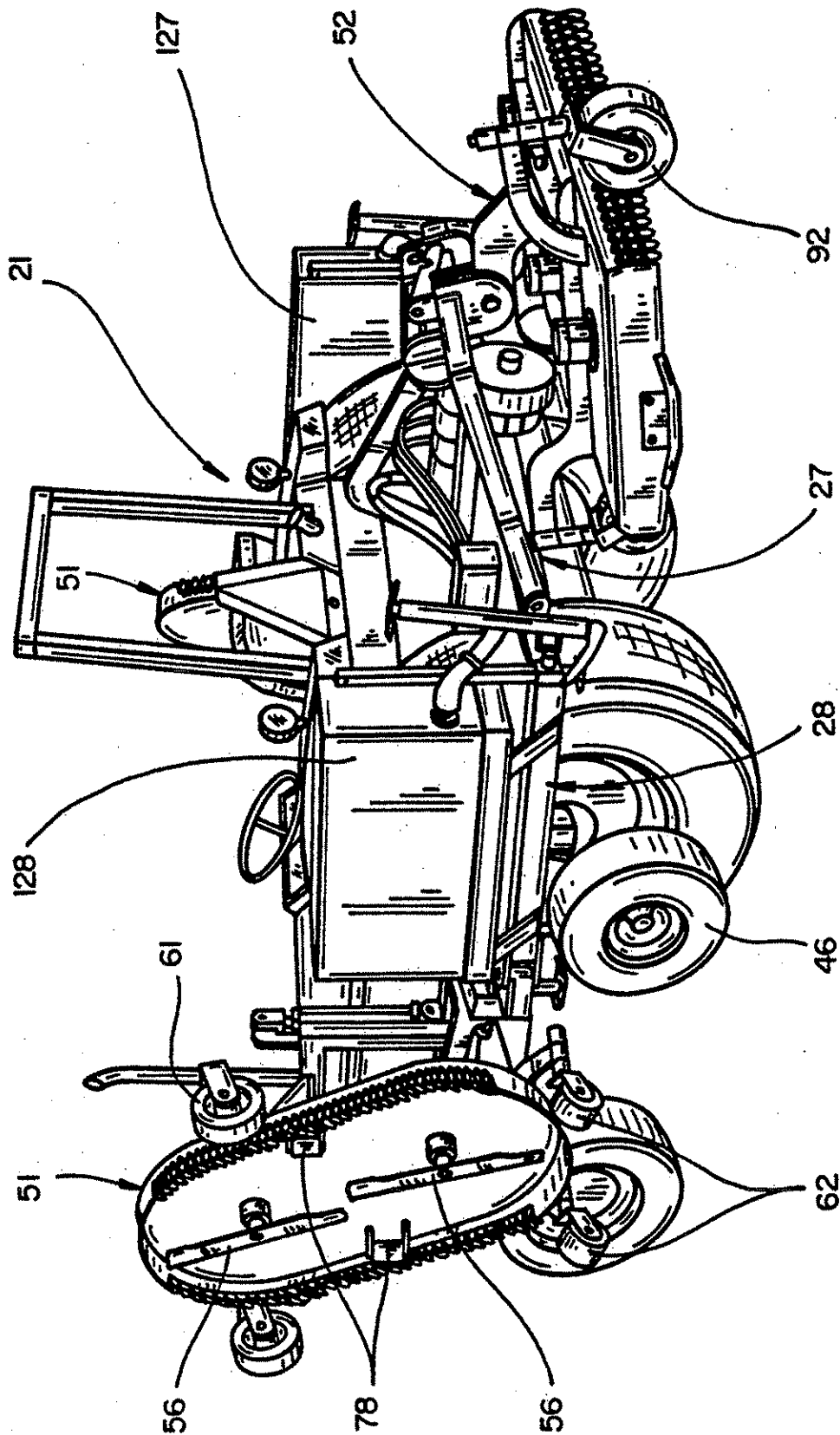


FIG. 3

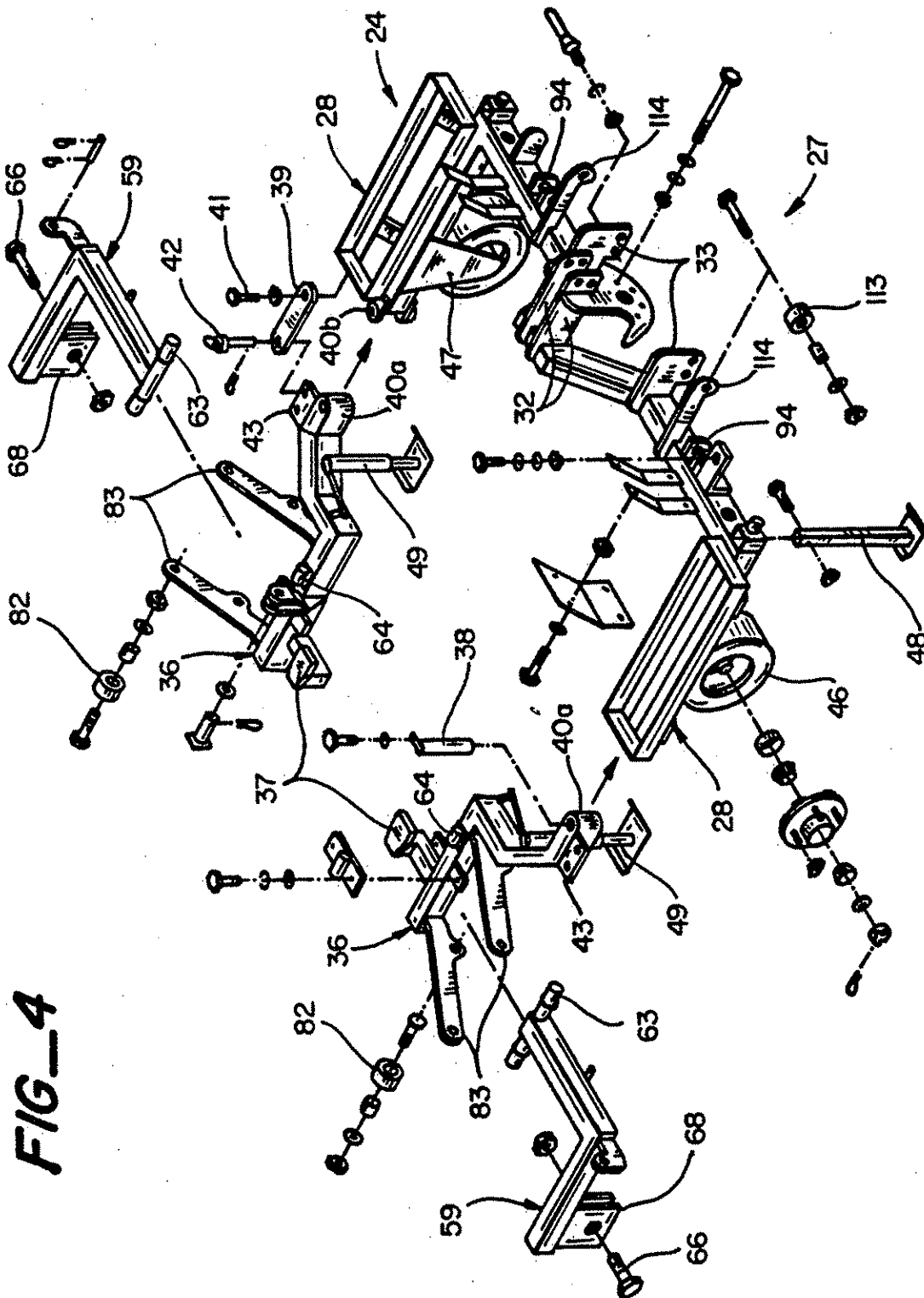
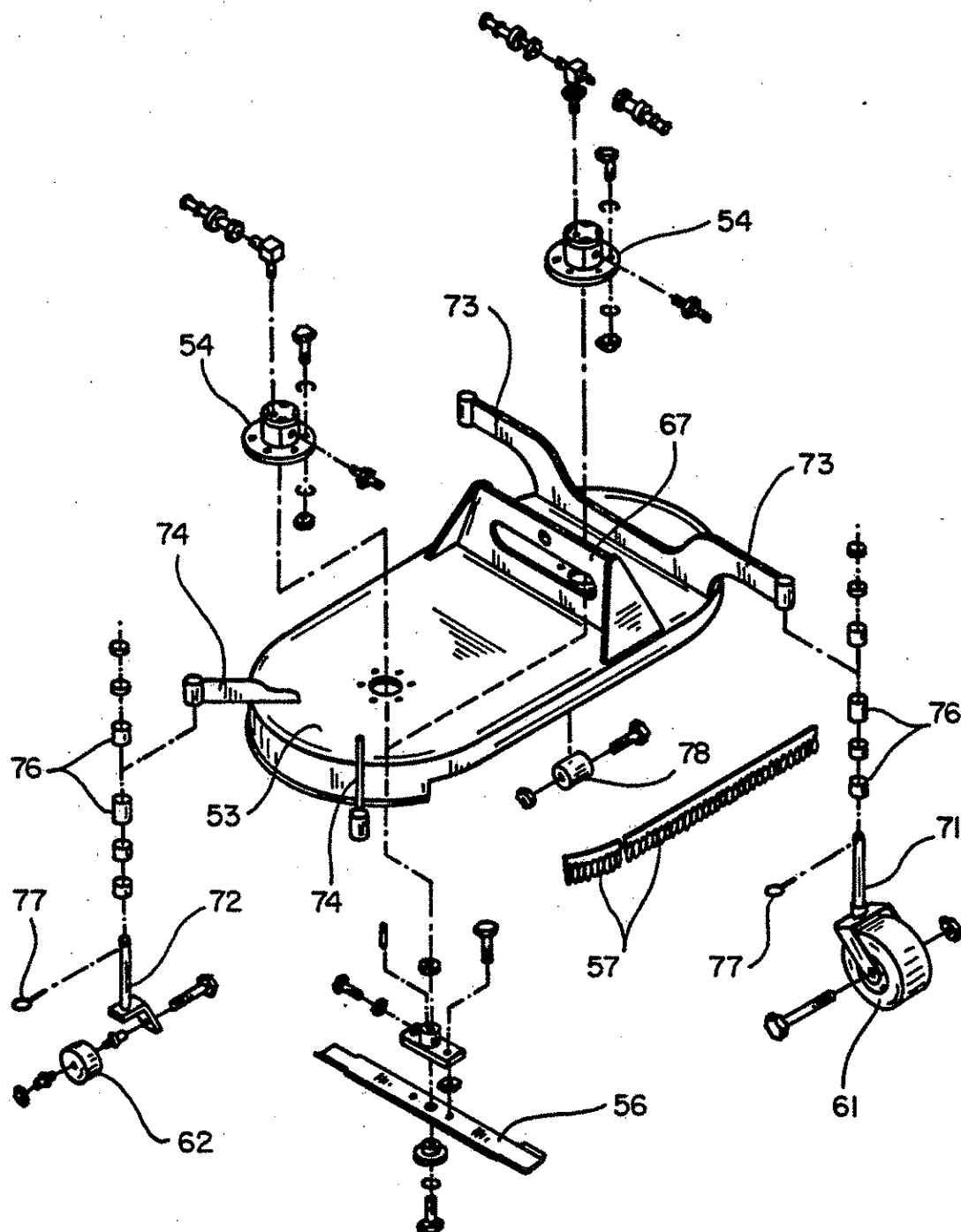


FIG-4



**FIG\_5**





**FIG. 7**

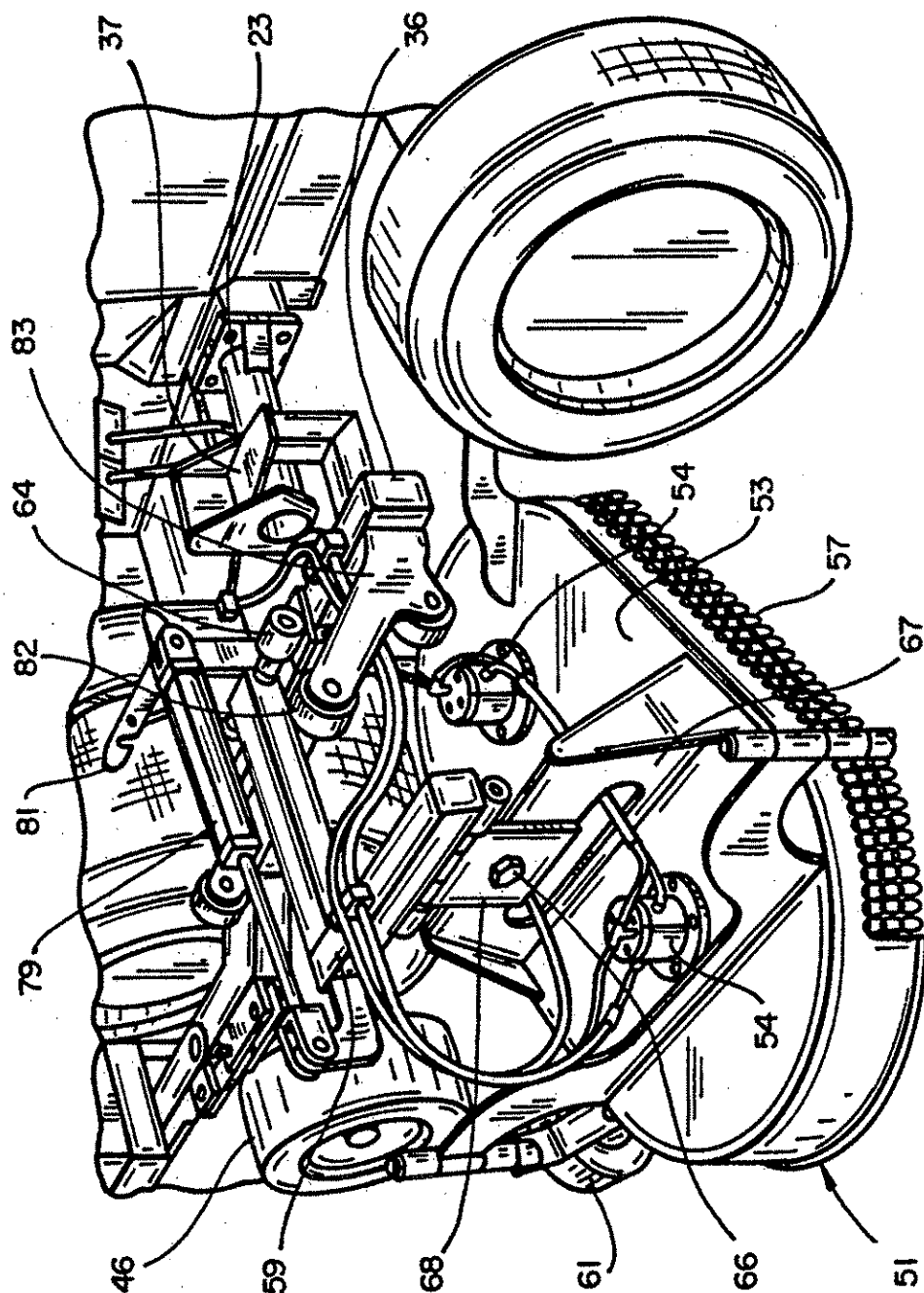
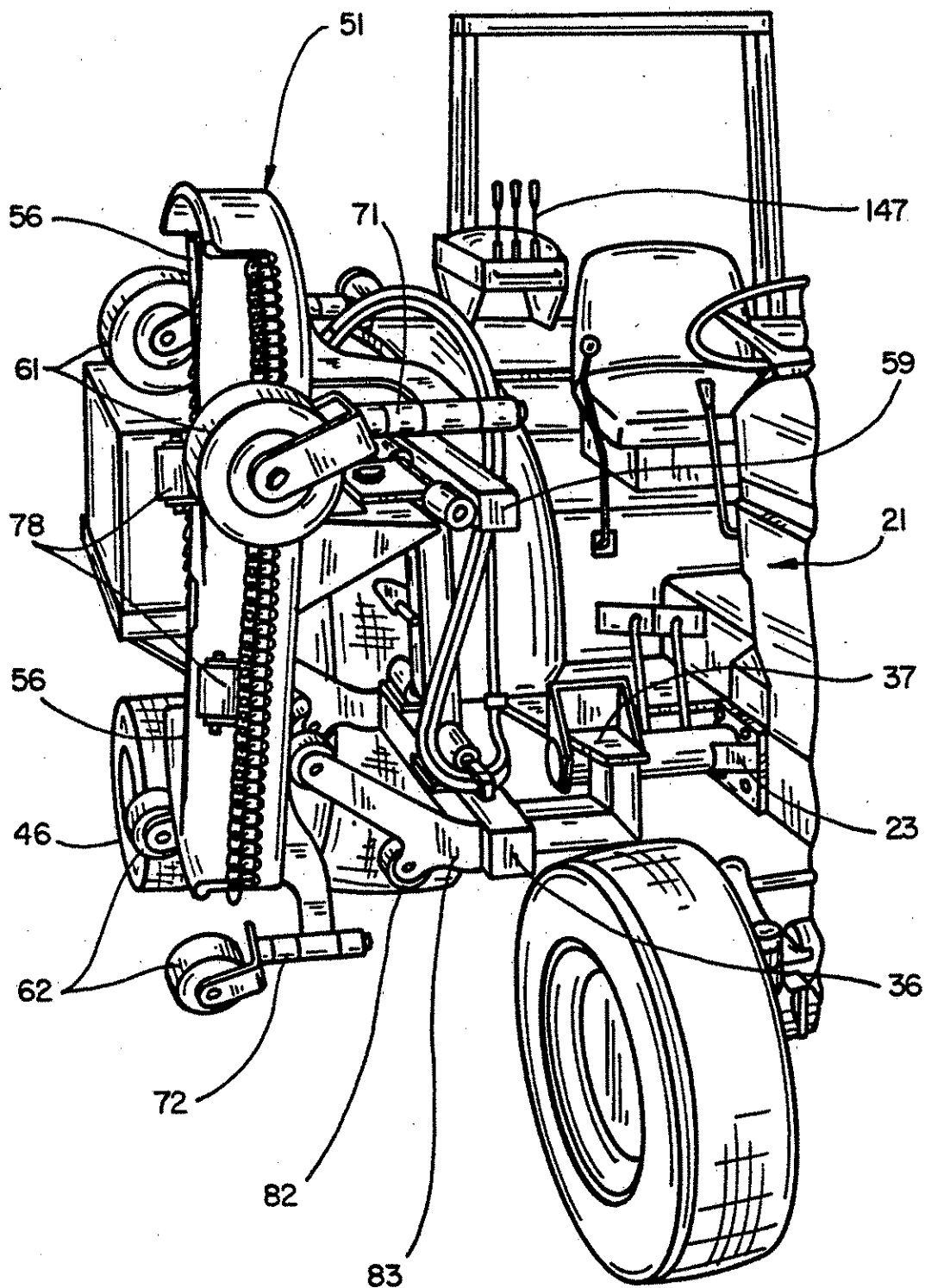


FIG-8

**FIG\_9**

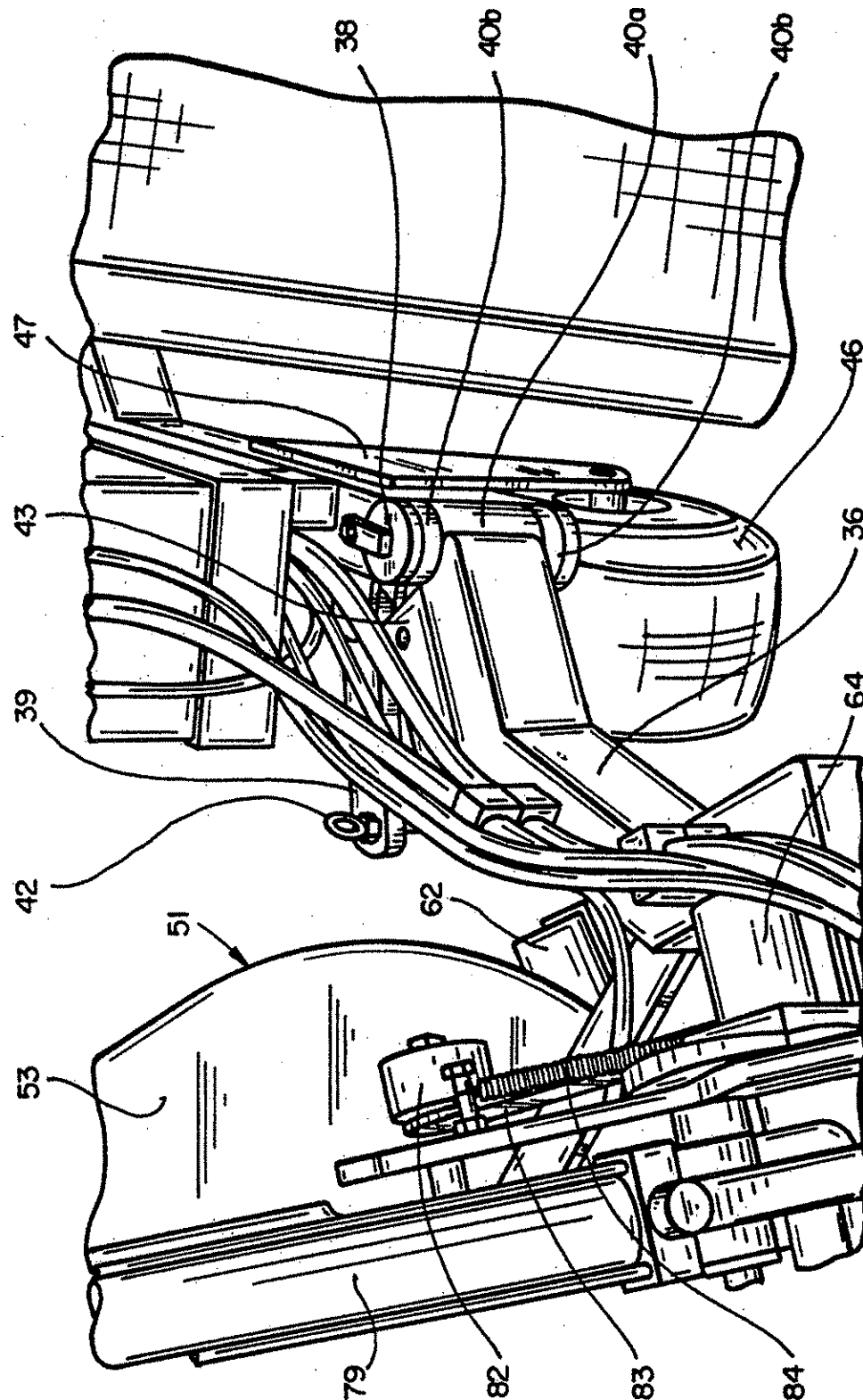
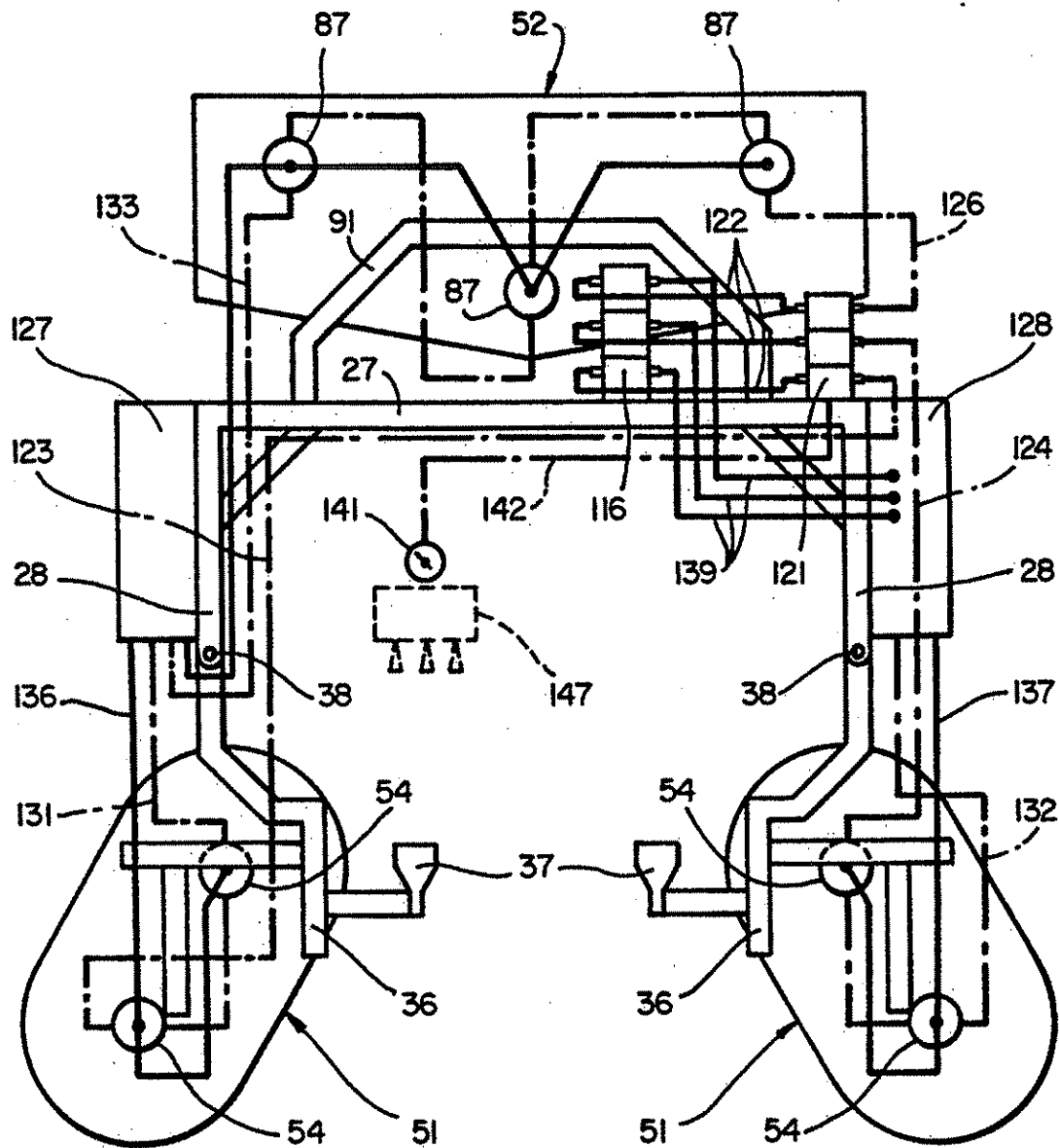
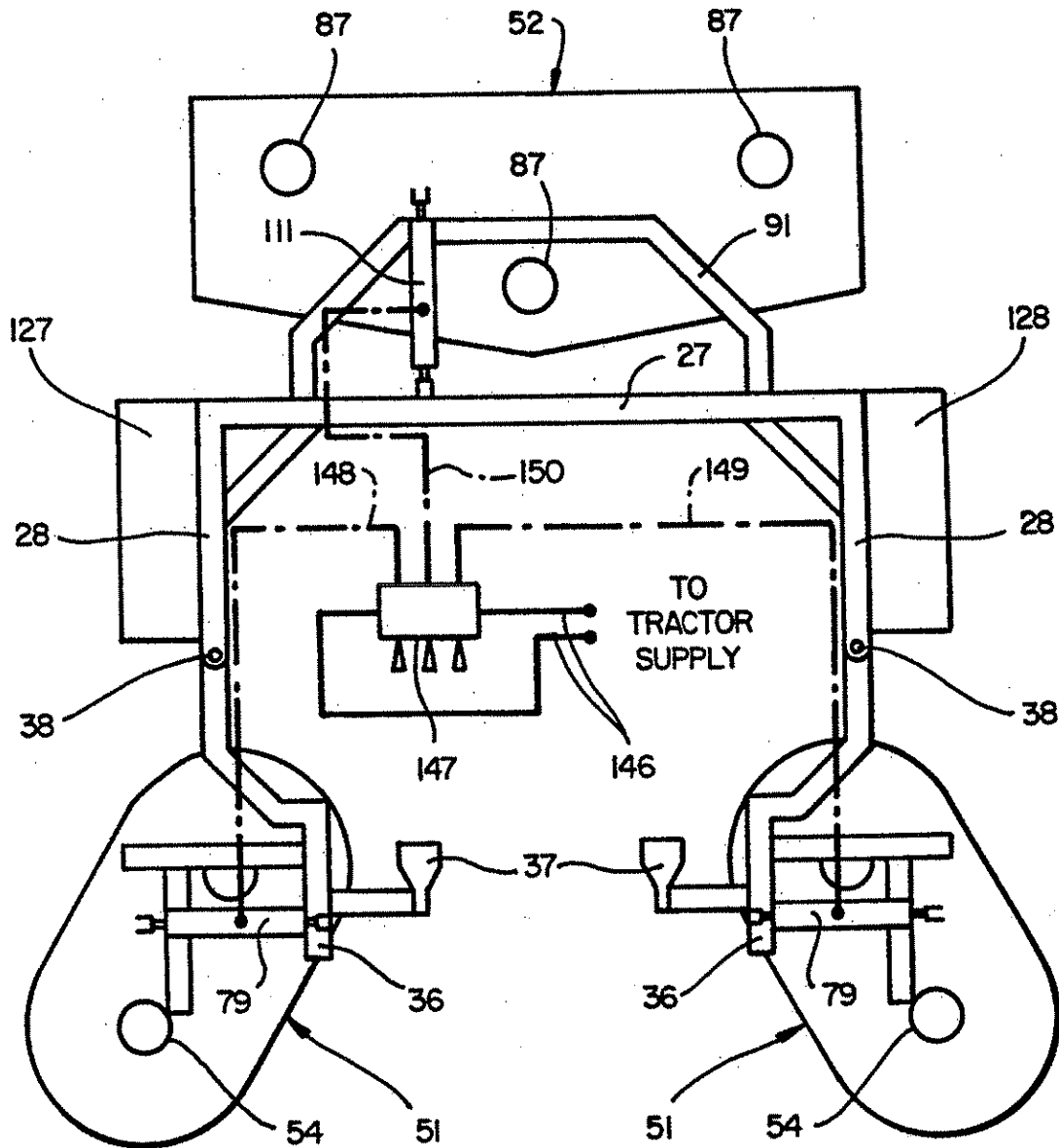


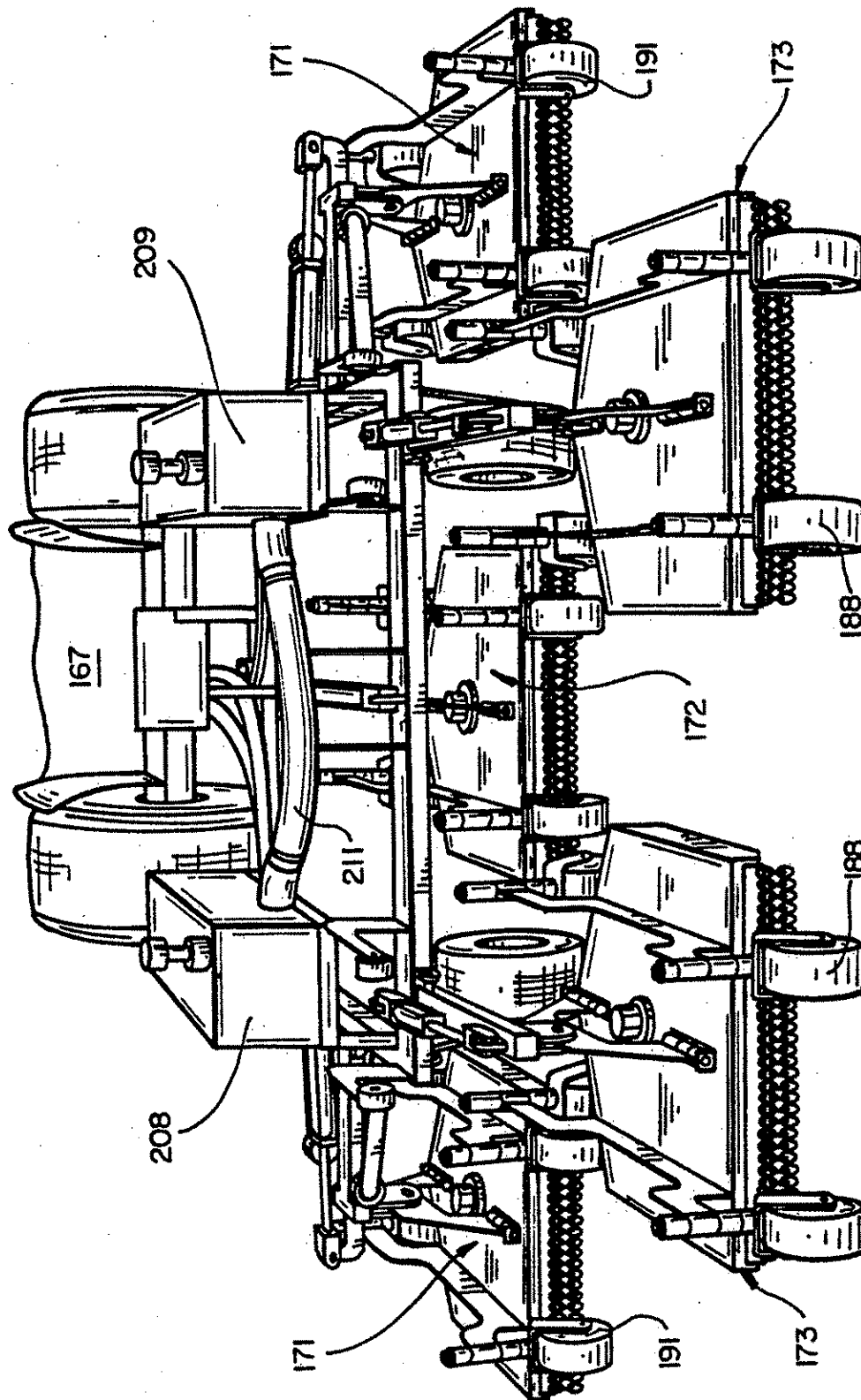
FIG. 10

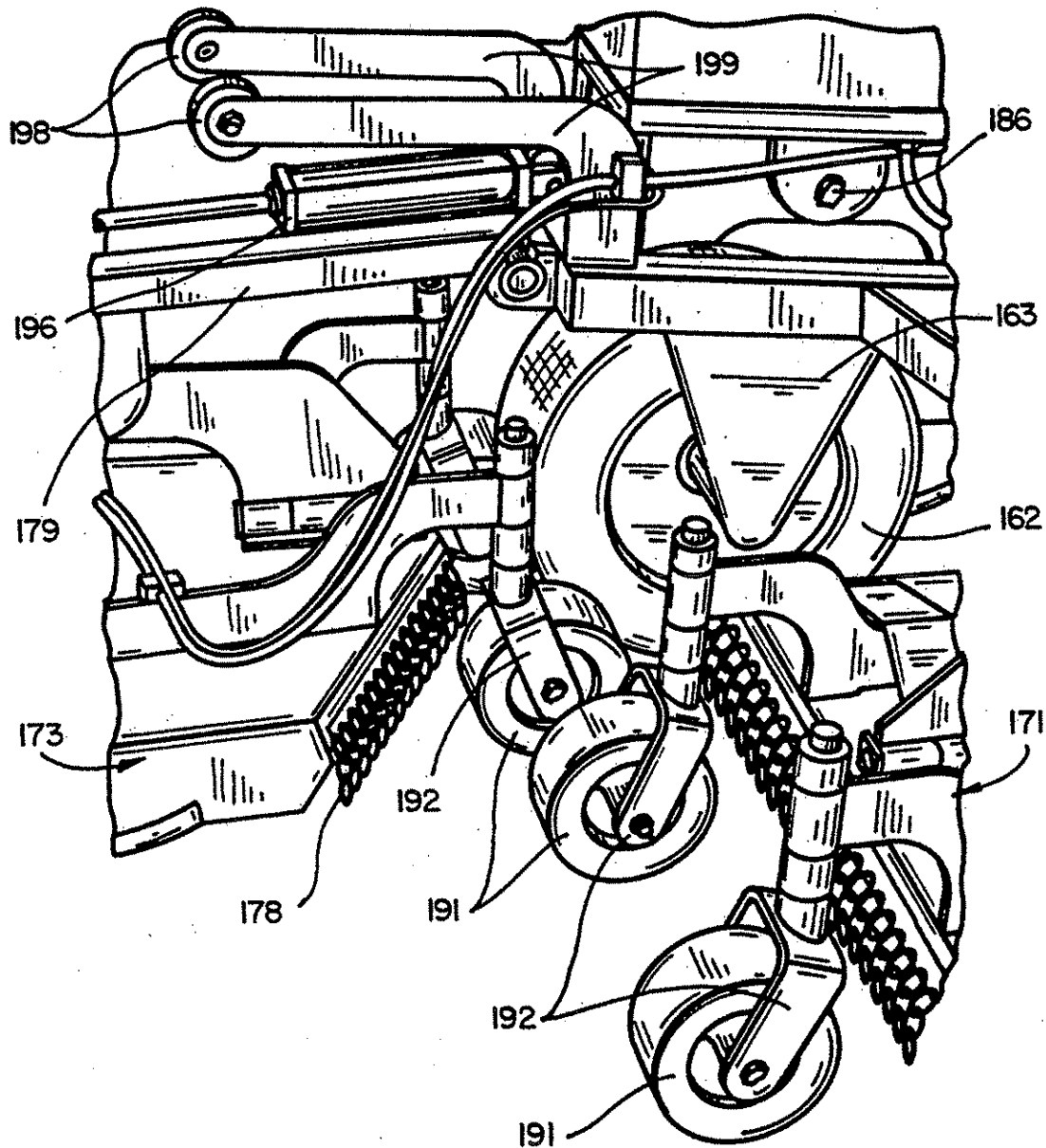


**FIG\_II**



**FIG\_12**

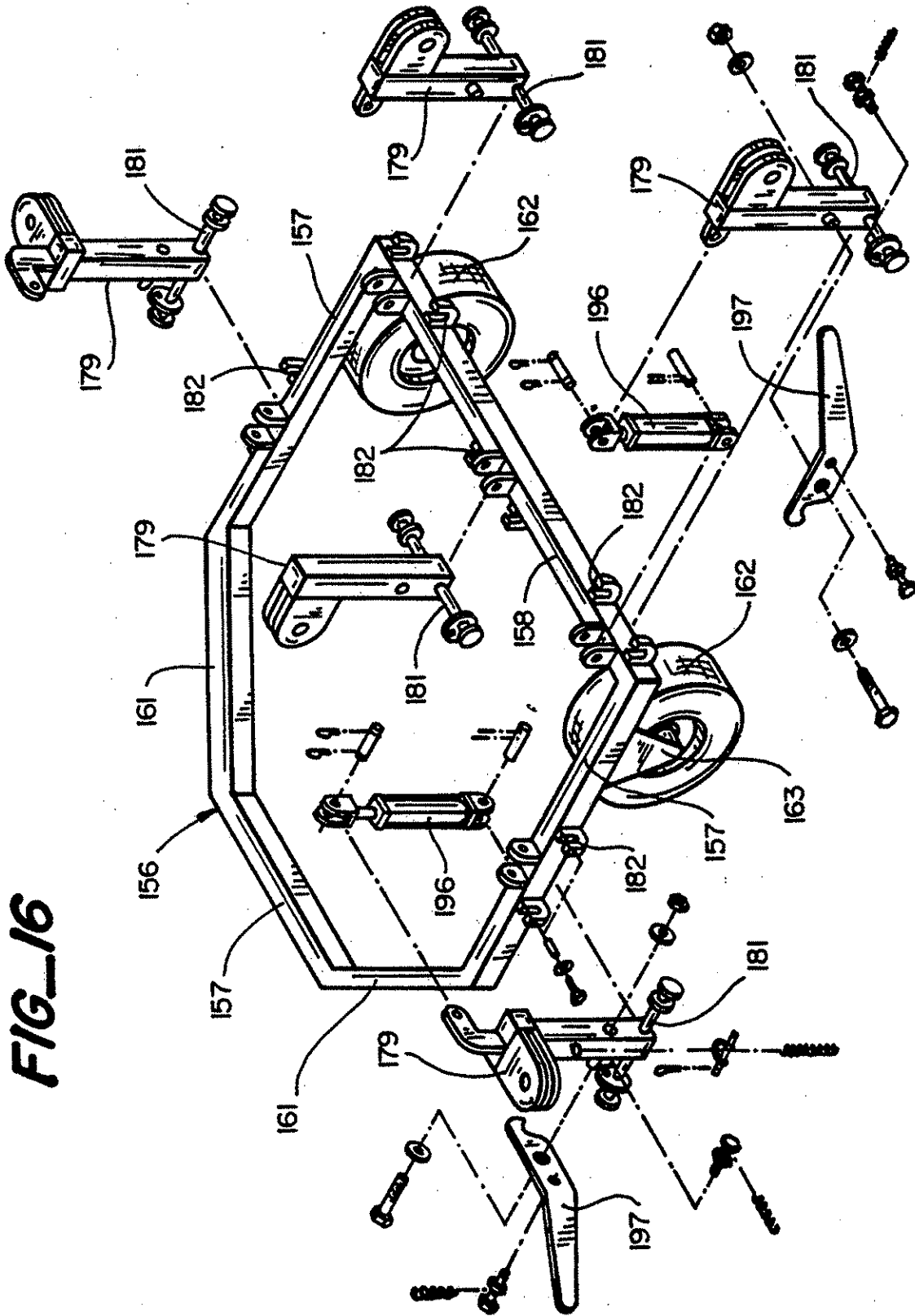


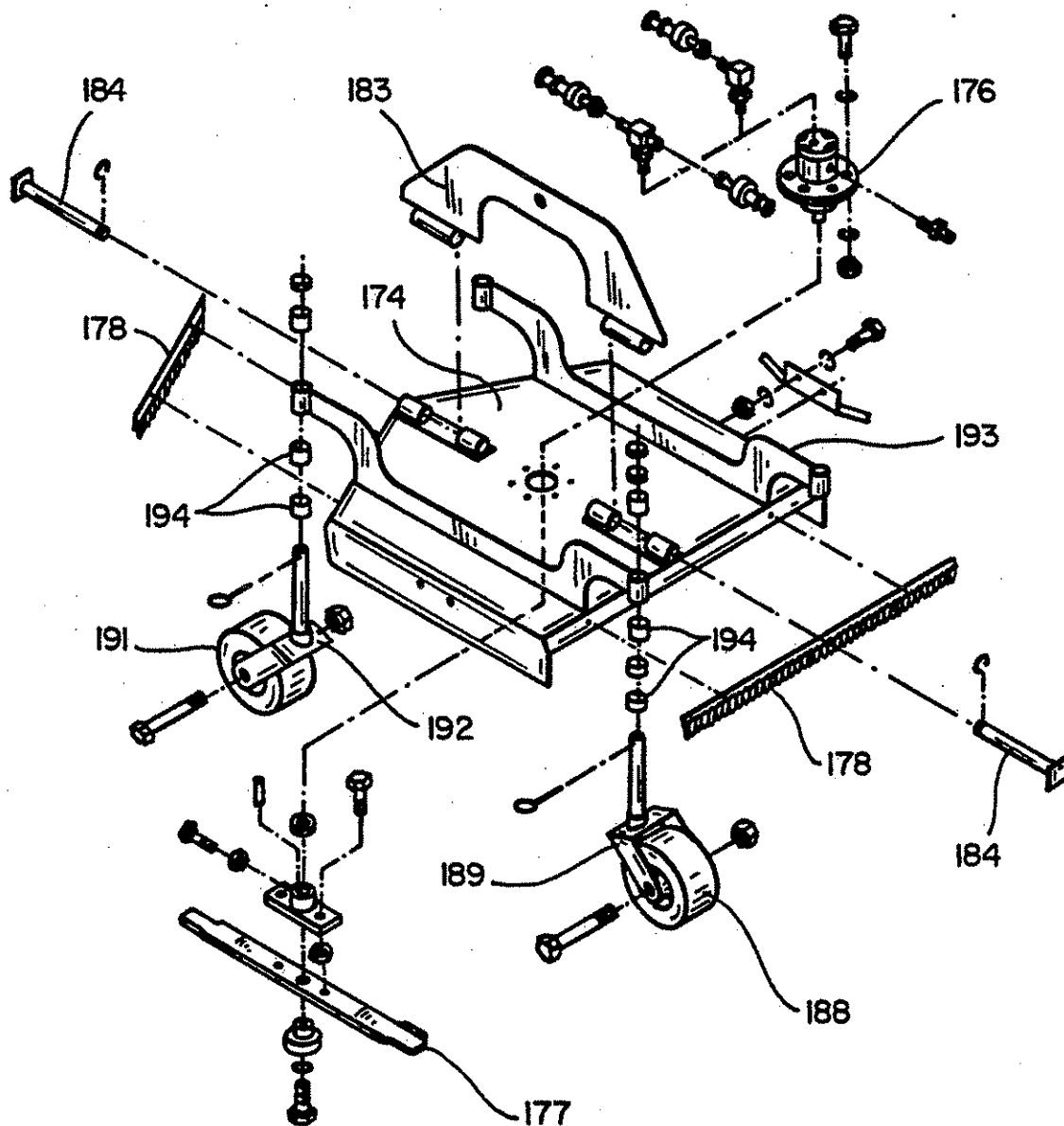


**FIG\_14**



FIG. 16





**FIG\_17**

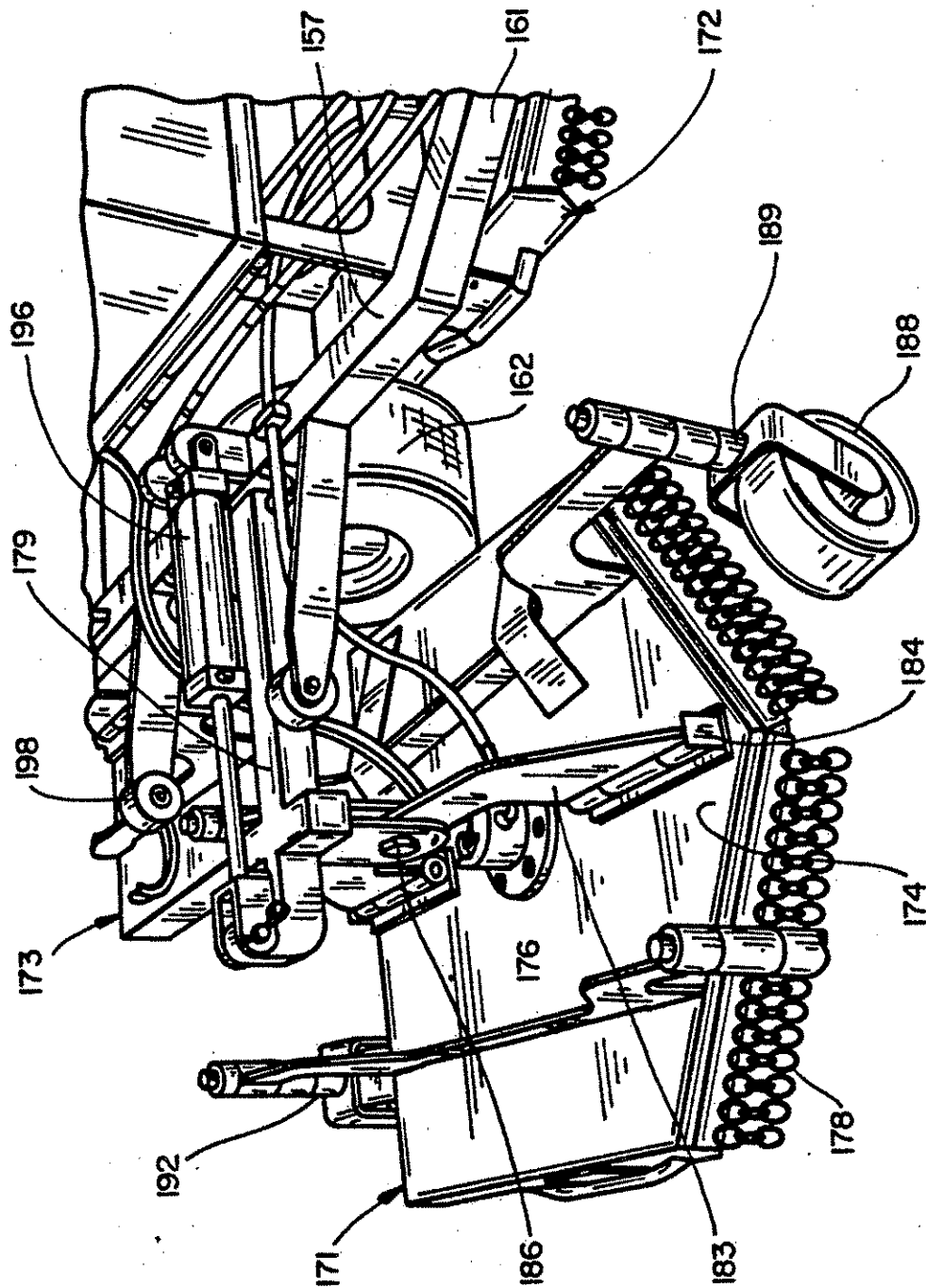
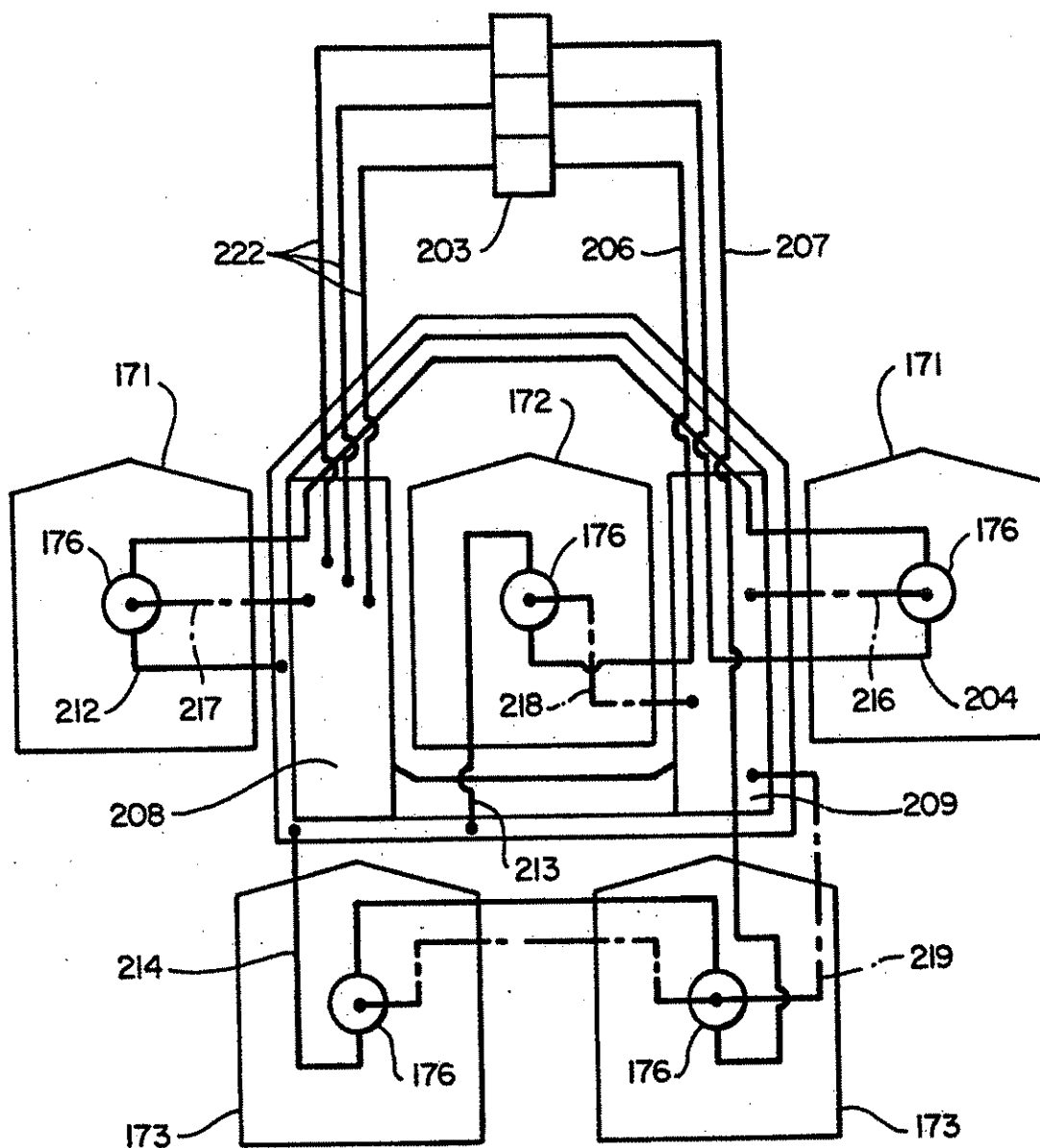
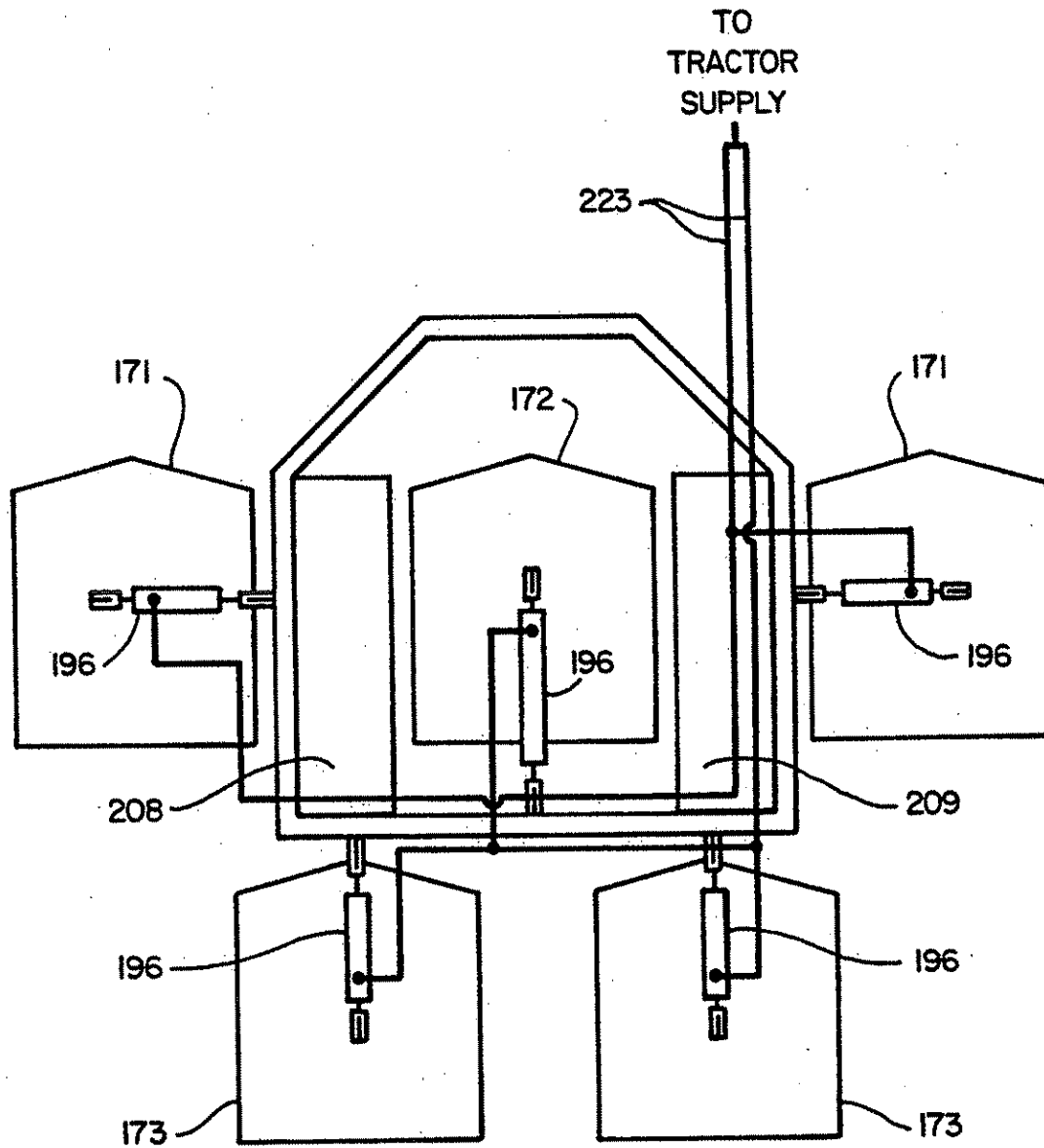


FIG. 18

**FIG\_19**



**FIG. 20**

# 1 WIDE AREA LAWNMOWER

This invention pertains generally to lawn mowing equipment and, more particularly, to a wide area lawn mower for use in cutting large areas of grass such as those found at golf courses, athletic fields, and parks.

Lawn mowers for use in large areas are usually attached to a motorized vehicle such as a tractor or constructed integrally with a propelling vehicle. Mowers used with tractors have an advantage in that the tractors can be used for other purposes, but this usually requires that the mower be disconnected from the tractor, which can be a time consuming procedure. Some mowers can, for example, take as long as 15-20 hours to connect to or disconnect from a tractor, which is somewhat of an inconvenience.

Wide area mowers generally have a plurality of cutting units, e.g. reels, which may be arranged in an overlapping pattern to avoid leaving uncut areas of grass between the different cutters. This problem is commonly known as "stripping". While it is relatively easy to arrange the cutting units to avoid stripping when the mower travels in a straight line, stripping can still occur when the mower goes around curves and the cutters follow different paths relative to each other. This problem increases as the curvature become sharper, and stripping therefore limits the curves which many mowers can cut.

Mowers with multiple cutters can also require relatively high maintenance and frequent adjustment of parts such as belts and pulleys associated with the various cutters.

It is in general an object of the invention to provide a new and improved wide area mower for cutting large areas of grass.

Another object of the invention is to provide a lawn-mower of the above character which overcomes the limitations and disadvantages of wide area mowers heretofore provided.

These and other objects are achieved in accordance with the invention by providing a wide area mower which can be attached to and detached from a tractor in a relatively short time. In one disclosed embodiment, the mower has a main frame which is detachably connected to the rear mount of a tractor, swing frames pivotally connected to the main frame for movement into and out of engagement with the side mounts of the tractor, means detachably locking the swing frames in engagement with the side mounts, and mowing heads mounted on the frames to the sides and rear of the tractor. Each of the mowing heads includes a horizontally extending deck and a grass cutting blade rotatively driven in a generally horizontal plane beneath the deck by a hydraulically actuated motor. Ground engaging wheels attached to the decks position the blades a predetermined distance above the ground, and anti-scalping rollers mounted on the undersides of the decks project below the blades for engagement with high areas of the ground to prevent the blades from contacting the ground in the event that the heads pass over uneven ground.

In another disclosed embodiment, the mower includes a frame adapted for connection to a towing vehicle, a pair of side decks positioned on opposite sides of the frame, a center deck positioned between the side decks, a pair of rear decks positioned to the rear of and between the side decks and the center deck, grass cut-

ting blades rotatively driven in a generally horizontal plane beneath the decks, ground engaging wheels at the front and rear of each deck for supporting the blades at predetermined heights above the ground, the wheels at the rear of the side decks and the center deck being aligned with the wheels at the front of the rear decks, and means pivotally mounting the decks to the frame so that the decks can follow the contour of ground over which they pass.

FIG. 1 is a left front isometric view of one embodiment of a wide area mower according to the invention.

FIG. 2 is a right rear isometric view of the embodiment of FIG. 1.

FIG. 3 is a left rear isometric view of the embodiment of FIG. 1, showing the mower decks in raised positions.

FIG. 4 is an exploded isometric view of frame assembly in the embodiment of FIG. 1.

FIG. 5 is an exploded isometric view of the side mower deck in the embodiment of FIG. 1.

FIG. 6 is an exploded isometric view of the rear mower deck in the embodiment of FIG. 1.

FIG. 7 is an exploded isometric view of the rear portion of the frame assembly and some of the hydraulic components in the embodiment of FIG. 1.

FIGS. 8-10 are operational views of the embodiment of FIG. 1.

FIGS. 11 and 12 are schematic diagrams of the hydraulic systems in the embodiment of FIG. 1.

FIG. 13 is a rear isometric view of another embodiment of a wide area mower according to the invention.

FIG. 14 is fragmentary isometric view of the embodiment of FIG. 13.

FIG. 15 is an isometric view of the frame in the embodiment of FIG. 13.

FIG. 16 is an exploded isometric view of the frame and lift wings for the mower decks in the embodiment of FIG. 13.

FIG. 17 is an exploded isometric view of one of the mower decks in the embodiment of FIG. 13.

FIG. 18 is a fragmentary isometric view of the embodiment of FIG. 13, illustrating one of the mower decks in its normal operating position.

FIGS. 19 and 20 are schematic diagrams of the hydraulic systems in the embodiment of FIG. 13.

In FIG. 1, the invention is illustrated in conjunction with a tractor 21, which in this particular example is a John Deere Model 1070, although any suitable tractor can be used. The tractor has a conventional 3-point mount 22 at the rear and mounts 23 on the sides for the attachment of auxiliary equipment. In the case of the John Deere tractor shown, mounts 23 are commonly used for mounting a loader (not shown) which extends in front of the tractor.

In the embodiment of FIG. 1, the mower has a U-shaped main frame 26 which includes a rear section 27 and side sections 28. The rear section of the frame extends across the rear of the tractor is affixed to the 3-point mount by a top link 29 and side links 31. The side sections extend along the sides of the tractor outboard of the rear tires to points near the fronts of those tires. The frame is formed as a rigid weldment of 3x4 inch box tube, with mounts 32, 33 for the top and side links. The links are connected to the 3-point mount by removable pins 34 which permit the mower to be readily attached to and detached from the tractor.

Swing frames 36 are pivotally connected to the front ends of the side sections of frame 26 for movement into and out of engagement with the mounts 23 at the sides

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of the tractor. The swing frames have pads 37 which rest upon the mounts when they are engaged. The swing frames are connected to the main frame by hinge pins 38, with links 39 locking the swing arms in the inner or engaged position. The hinge pins are received in knuckles 40a, 40b at the confronting ends of the frames, and the lock links are pivotally connected to the main frame by bolts 41. The lock links are detachably connected to the swing frames by removable pins 42 which pass through aligned openings in the links and in vertically spaced, horizontally extending pairs of flanges 43 affixed to the swing frames, with the links being received between the flanges in the locking position.

The frame is supported by ground engaging wheels 46 which are mounted on flanges 47 that depend from the side members of the frame. Jack stands 48, 49 are provided for supporting the frame in an elevated position when the mower is detached from the tractor, with jack stands 48 being positioned at the rear corners of the main frame and jack stands 49 being mounted on the swing frames. When not in use, stands 49 are stowed in an inverted position at the rear of the main frame.

A plurality of mowing heads are mounted on the frame assembly. These include side mower decks 51 which are mounted on the swing arms on opposite sides of the tractor and a rear mower deck 52 which is mounted on the rear section of the main frame to the rear of the tractor.

Each of the side mower decks includes a horizontally extending deck 53 with a pair of hydraulically actuated motors 54 mounted thereon, and grass cutting blades 56 mounted on the motor shafts for rotation in generally horizontal planes beneath the deck. Chain link guards 57 extend along the front and rear edges of the decks to prevent rocks and other projectiles from being thrown out from under the decks by the rotating blades. In the particular embodiment shown, the side decks each have two blades, but a greater or lesser number can be employed, if desired, to provide a wider or narrower cutting area.

The side decks are floatably mounted on lift wings 59 and have wheels 61, 62 which engage the ground and follow the contour of the terrain over which the decks pass. The lift wings are pivotally connected to the swing frames by spindles 63 which are mounted in bushings 64 on the swing frames. The decks are pivotally connected to the lift wings for movement about mutually perpendicular axes so that they can follow the contour of the ground. Pivot bolts 66 connect mounting flanges 67 on the deck to mounts 68 which are hingedly mounted on the lift arms. The hinge axes are parallel to the axes of spindles 63 and perpendicular to the axes of the pivot bolts.

Wheels 61, 62 are mounted on forks 71, 72 which are pivotally mounted in bushings on arms 73, 74 for swivelling movement about vertically extending axes. A series of spacers 76 is placed on the spindle of each fork, and the height of the blades above the ground, i.e. the height of the cut, is determined by the number of spacers beneath the bushings. The forks are retained in the bushings by Lynch pins 77. To minimize the power required for cutting, the wheels can be adjusted so that the front side of each deck is slightly lower than the rear side so the blades only have to cut through the grass during the front half of their rotation.

Anti-scalping rollers 78 are mounted under the decks to prevent the blades from contacting the ground in the

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event that the mower travels over uneven terrain where the ground beneath the decks rises above the level of the ground engaged by the deck wheels. These rollers extend about one inch below the planes of the blades and will engage raised ground to prevent the blades from contacting it.

Hydraulically actuated cylinders 79 are connected between the swing arms and the lift wings for raising the side decks to a generally vertical position, and latch hooks 81 hold the decks in the raised position. Kick-out rollers 82 mounted on arms 83 which extend from the swing frames engage the decks as they are raised, guiding them to their vertical position. In that position, the decks are held firmly against the kick-out rollers by springs 84.

Rear mower deck 52 has a horizontally extending deck 86 with three hydraulically actuated motors 87 mounted thereon, and grass cutting blades 88 mounted on the motor shafts. Chain link guards 89 extend along the front and rear edges of this deck to prevent rocks and other projectiles from being thrown by the rotating blades.

The rear deck is floatably mounted on a lift wing 91 and has ground engaging wheels 92. The lift wing is pivotally connected to the rear section of the main frame by pivot pins 93 which are received in mounts 94 on the frame. Like the side decks, the rear deck is pivotally connected to the lift wing for movement about mutually perpendicular axes so that it, too, can follow the contour of the ground. In this regard an arched mounting arm 96 is pivotally connected to the deck by pins 97 which are received in bushings 98 affixed to crossmembers 99 on the deck. Arm 96 is pivotally connected to the lift wing by a bolt 101, the axis of which is perpendicular to the axes of pins 97.

Wheels 92 are mounted on forks 102 which are pivotally mounted in bushings on arms 103 for swivelling movement about vertically extending axes. As in the case of the side decks, the cutting height of the blades in the rear deck is adjusted by means of spacers 104 on the fork spindles. Here again, the power required for cutting can be minimized by adjusting the wheels so that the front side of the deck is slightly lower than the rear side so the blades only have to cut through the grass during the front half of their rotation.

Anti-scalping rollers 106, 107 similar to rollers 78 prevent the blades in the rear deck from contacting high spots in the ground. Rollers 106 are spaced across the rear of the deck, and roller 107 is mounted on a pair of downwardly curved arms 109 at the front of the deck. The rollers extend about one inch below the planes of the blades and will contact high spots to prevent the blades from striking them.

A hydraulically actuated cylinder 111 is connected between the main frame and the lift wing for raising the rear deck, and a latch hook 112 holds the deck in the raised position. Kick-out rollers 113 are mounted on arms 114 on the frame to guide the deck as it is raised and to help steady it in the raised position.

The mower decks and the blades therein are positioned in a manner which permits the mower to cut around very sharp curves as well as in straight lines without leaving any uncut strips between the blades. In this regard, it will be noted that there is substantial overlap between the blades in the side decks and the blades in the rear deck, as well as between the adjacent blades in the individual decks. The overlap between the inner blades in the side decks and the outer blades in the

rear deck is on the order of one-half of the length of the blades, and the blades in the individual decks are offset obliquely of each other so that the gap between the blades will not result in an uncut strip when the mower is travelling in a forward direction or around a curve.

A hydraulic pump 116 provides pressurized fluid for operating the blade motors. The pump is mounted on a mount 117 on the rear section of the main frame and is driven from the power take-off at the rear of the tractor by a drive shaft 118 and a step-up transmission 119. The transmission is mounted on the back of the pump, and the shaft passes beneath the pump to the transmission. The shaft speed is on the order of 500-600 rpm, and the transmission provides a step-up of approximately 3.8:1, which makes it possible to use a smaller pump than would otherwise be required to supply the amount of fluid required by the motors. The shaft is connected to the power take-off by a quick release connector which is readily engaged and disengaged as the mower is attached to and detached from the tractor.

The pump has three sections or stages, and pressurized fluid from the pump is delivered to a manifold 121 which is mounted on the rear section of the frame near the pump. Lines 122 carry the fluid from the pump to the manifold, and lines 123, 124 and 126 carry the fluid from the manifold to the motors in the side and rear decks. The motors in each individual deck are fed in series, and the three decks are fed in parallel.

Rectangular tanks or reservoirs 127, 128 for the fluid are mounted on the frame, and fluid is carried between the two tanks through the rear section of the frame. Fluid is returned to the tanks from the motors by return lines 131-133 and by case drain lines 136-138, and fluid is supplied to the pump from the tank 128 by lines 139.

Pressure in the motor operating system is monitored by a gauge 141 connected to manifold 121 by a line 142. The gauge is removably mounted on the tractor near the operator's seat and is removed when the trailer is detached.

Means is provided for interrupting the application of fluid to the motors to stop the blades when the decks are raised. This means includes a solenoid operated valve 143 connected to the manifold and limit switches 144 which are actuated when the decks are raised or inclined by more than a predetermined amount, e.g. an angle of 15 degrees.

Pressurized fluid for operating the cylinders which raise the decks is obtained from the hydraulic system of the tractor through supply lines 146 which are connected to the tractor's system by quick connect/disconnect fittings. The fluid is supplied to the cylinders via control valves 147 and lines 148-150, with each valve controlling the operation of one cylinder. The control valves are mounted on a console 153 which is removably mounted on the armrest of the operator's seat on the tractor. When the mower is detached from the tractor, the console is mounted on a bracket 154 on the rear lift wing.

In operation, the mower of FIG. 1 is attached to the tractor, with wheels 46 resting on the ground, the mower decks are lowered so that their wheels also rest on the ground, blade motors 54, 87 are actuated, and the tractor is driven over the area to be mowed. Being free-floating, the decks follow the contour of the ground, and the grass is cut to a substantially uniform length. In the event that uneven terrain is encountered, the anti-scalping rollers will prevent the blades from striking the ground. Whenever one of the decks is raised

by an angle of more than 15 degrees, the limit switches and solenoid operated valve cut off the supply of fluid to the motors, stopping the blades.

To detach the mower from the tractor, the mower assembly is lifted off the ground by the 3-point hitch on the tractor, thereby lifting swing frame pads 37 off the mounts 23 at the sides of the tractor. Pins 42 are then removed, and the swing frames and side decks are swung out away from the tractor. Jack stands 48, 49 are then lowered to support the mower, drive shaft 118 and hydraulic lines 146 are disconnected from the power take-off and hydraulic system of the tractor, the control valve console and pressure gauge are removed from the tractor, and pins 34 are removed to disconnect the links from the 3-point hitch. The tractor can then be driven away from the mower. The entire process takes no more than about 20 minutes, which is a significant improvement over the 20 hours it takes to disconnect other mowers from tractors. The mower is attached to the tractor by substantially the reverse of this process, which can also be done very rapidly.

In the embodiment of FIG. 13, the mower has a frame 156 with side members 157, a rear crossmember 158, and front members 159, 161. Ground engaging wheels 162 are mounted on depending flanges 163 toward the rear of the side members, and a drawbar or tongue 164 extends in a forward direction from front member 159, with a hitch 166 at the front end thereof for connection to a tractor 167. The frame is formed as a rigid unitary weldment of a suitable material such as 3x3 inch box tube. A jackstand 168 is mounted on the tongue for supporting the front portion of the mower when it is disconnected from the tractor. The jackstand is stowed in a horizontal position and is turned to a vertical position for use.

Five mower decks are mounted on frame 156. These include a pair of side decks 171 on opposite sides of the frame, a center deck 172 positioned between the side decks, and a pair of rear decks 173 positioned to the rear of and between the side decks and the center deck. Each of the decks includes a horizontally extending deck 174, with a hydraulically actuated motor 176 mounted thereon and a grass cutting blade 177 attached to the shaft of the motor for rotation in a generally horizontal plane beneath the deck. Chain link guards 178 extend along the front and rear edges of the decks to prevent rocks and other projectiles from being thrown out from under the decks by the rotating blades.

The decks are floatably mounted on lift wings 179 and have wheels which engage the ground and follow the contour of the terrain over which the decks pass. The lift wings are pivotally connected to the frame by spindles 181 and mounts 182, with the two side decks being positioned outboard of side members 157, the central deck being positioned in front of rear crossmember 158, and the rear decks positioned to the rear of the rear crossmember.

As in the embodiment of FIG. 1, each of the decks is pivotally connected to the associated lift wing for movement about mutually perpendicular axes so that it can follow the contour of the ground. An arched mounting arm 183 is hinged to each deck by pins 184 which extend along axes parallel to the longitudinal axis of the mower, or the direction of travel. This arm is pivotally connected to the lift wing by a bolt 186, the axis of which is perpendicular to the axes of pins 184.

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Wheels 188 are mounted in forks 189 at the front of the side and center decks and at the rear of the rear decks, and wheels 191 are mounted in forks 192 at the rear of the side and center decks and at the front of the rear decks. The shafts of the forks are mounted in arms 193 which extend from the decks, with spacers 194 on the shafts determining the height of the blades above the ground. As in the embodiment of FIG. 1, the power required for cutting can be minimized by adjusting the wheels so that the front side of the deck is slightly lower than the rear side so the blades only have to cut through the grass during the front half of their rotation.

Wheels 188 are similar to wheels 191, but forks 189 and 191 differ in that forks 189 have round shafts but forks 192 have square shafts. Wheels 188 are thus free to swivel about the axes of their fork shafts, whereas wheels 191 are constrained against such swivelling. Wheels 191 are also aligned along an axis slightly to the rear of the main wheels 162 of the mower. Having these wheels aligned in this manner and constrained against swivelling helps to keep decks under control and in proper alignment on curves so that the mower can cut around relatively sharp curves without leaving uncut strips of grass between the blades in the different decks. The axis of wheels 191 is preferably kept as close to the axis of wheels 162 as possible to avoid any appreciable skidding of the wheels when going around curves.

If needed, anti-scalping rollers can be mounted under the decks, as in the embodiment of FIG. 1, to prevent the blades from contacting high spots in the ground. However, with only one blade in each deck, the deck wheels are close enough to each other that scalping is generally not a problem even in relatively uneven terrain.

Hydraulically actuated cylinders 196 are connected between the frame and the lift wings for raising all five of the decks to substantially vertical positions, and latch hooks 197 hold the decks in the raised position. Kick-out rollers 198 are mounted on arms 199 on the frame to guide the decks as they are raised and to help steady them in the raised position. In that position, the decks are held firmly against the kick-out rollers by springs 201.

Pressurized fluid for operating the blade motors is provided by a pump 203 similar to pump 116. In this embodiment, however, the pump and step-up transmission are mounted on the tractor, and the lines are removably connected to the pump with quick connect/disconnect fittings. The drive shaft is permanently connected to the power take-off and to the transmission.

Lines 204, 206 and 207 carry pressurized fluid from the pump to the motors in the side, center and rear decks, respectively, with the motors in the two side decks being fed in series with each other and the motors in the two rear decks being fed in series with each other.

The fluid is stored in reservoirs or tanks 208, 209 which are mounted on the side members of the frame, with a relatively large line 211 interconnecting the two tanks. In this embodiment, the frame is utilized in the return line, and fluid is returned to the tanks from the motors by lines 212-214 which are connected between the motors and the frame. Fluid leaking into the motor cases is returned to the tanks by lines 216-219, and fluid is delivered to the pump from tank 208 by lines 221. As noted above lines 204, 206, 207 and 221 are connected to the pump with quick connect/disconnect fittings.

Pressurized fluid for operating the cylinders which raise the decks is obtained from the hydraulic system of

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the tractor through supply lines 223 which are connected to the tractor's system by quick connect/disconnect fittings.

As in the embodiment of FIG. 1, limit switches and a solenoid operated valve interrupt the application of fluid to the motors to stop the blades when the decks are raised.

Operation and use of the embodiment of FIG. 13 is similar to that previously described, except attachment and detachment of the mower are even easier in this embodiment, requiring only the insertion or removal of a pin and the connection or disconnection of a few hydraulic lines.

It is apparent from the foregoing that a new and improved wide area mower has been provided. While only certain presently preferred embodiments have been described in detail, as will be apparent to those familiar with the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

We claim:

1. Lawn mowing apparatus, comprising: a tractor having rear and side mounts for attachment of auxiliary equipment, a main frame detachably connected to the rear mount, swing frames pivotally connected to the main frame for movement into and out of engagement with the side mounts, means detachably locking the swing frames in engagement with the side mounts, and mowing heads mounted on the frames to the sides and rear of the tractor for cutting grass over a relatively wide area.

2. The lawn mowing apparatus of claim 1 wherein the main frame is a U-shaped frame having a rear section positioned to the rear of the tractor and a pair of side sections which extend along opposite sides of the tractor.

3. The lawn mowing apparatus of claim 1 wherein the main frame is connected to the rear mount with removable pins, and the means detachably locking the swing frames in engagement with the side mounts comprises removable pins.

4. The lawn mowing apparatus of claim 1 wherein each of the mowing heads comprises a horizontally extending deck and a grass cutting blade rotatively driven in a generally horizontal plane beneath the deck.

5. The lawn mowing apparatus of claim 4 including ground engaging wheels attached to the deck for positioning the blade a predetermined distance above the ground.

6. The lawn mowing apparatus of claim 5 including anti-scalping rollers mounted on the underside of the deck and projecting below the blade for engagement with portions of the ground which rise above portions contacted by the wheels to prevent the blade from contacting the ground in the event that the head passes over uneven ground.

7. The lawn mowing apparatus of claim 4 including means for raising the decks of the mowing heads mounted on the swing frames to a generally vertical position.

8. The lawn mowing apparatus of claim 4 wherein the decks are pivotally mounted to the frames and adapted to follow the contour of the ground over which they pass, and the apparatus includes means for stopping rotation of the blades in the event that one of the decks rises away from the ground by more than a predetermined amount.

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9. The lawn mowing apparatus of claim 1 including hydraulically actuated motors on the mowing heads, a pump mounted on the main frame for supplying pressurized fluid to the motors, and a drive shaft operatively connecting the pump with a power take-off on the tractor.

10. The lawn mowing apparatus of claim 9 including a step-up transmission between the power take-off and the pump for driving the pump at a higher speed than the power take-off.

11. Lawn mowing apparatus for use with a tractor having rear and side mounts for attachment of auxiliary equipment, comprising a U-shaped frame having a rear section adapted to extend along the rear of the tractor and side sections adapted to extend along opposite sides of the tractor, means for detachably connecting the rear section to the rear mount, swing frames pivotally connected to the side sections for movement into and out of engagement with the side mounts, means for detachably locking the swing frames in engagement with the side mounts, and mowing heads mounted on the rear section of the U-shaped frame and on the swing frames for cutting grass over a relatively wide area.

12. The lawn mowing apparatus of claim 11 wherein the means for detachably connecting the rear section of the U-shaped frame to the rear mount and the means for detachably locking the swing frames in engagement with the side mounts comprise removable pins.

13. The lawn mowing apparatus of claim 11 wherein the mowing heads comprise horizontally extending decks, hydraulically actuated motors mounted on the decks with vertically extending shafts, and grass cutting blades mounted on the shafts for rotation in generally horizontal planes beneath the decks.

14. The lawn mowing apparatus of claim 13 including ground engaging wheels mounted on the decks for positioning the blades in the mowing heads a predetermined distance above the ground, and means pivotally mounting the decks on the frames so that the mowing heads can follow the contour of ground over which they pass.

15. The lawn mowing apparatus of claim 14 including anti-scalping rollers mounted on the undersides of the decks and projecting below the blades for engagement with portions of the ground which rise above portions contacted by the wheels to prevent the blades from contacting the ground in the event that the heads pass over uneven ground.

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16. The lawn mowing apparatus of claim 13 including a pump adapted to be driven by a power take-off on the tractor for supplying pressurized operating fluid to the motors.

17. The lawn mowing apparatus of claim 11 including means for raising the mowing heads which are mounted on the swing frames to a generally vertical position.

18. Lawn mowing apparatus, comprising: a frame adapted for connection to a towing vehicle and having a pair of axially aligned wheels, a pair of side decks positioned on opposite sides of the frame, a center deck positioned between the side decks, a pair of rear decks positioned to the rear of and between the side decks and the center deck, grass cutting blades rotatively driven in generally horizontal planes beneath the decks, ground engaging wheels at the front and rear of each deck for supporting the blades at predetermined heights above the ground, the wheels at the rear of the side decks and the center deck being aligned with the wheels at the front of the rear decks along an axis substantially parallel to and slightly to the rear of the axis of the pair of axially aligned wheels, and means pivotally mounting the decks to the frame so that the decks can follow the contour of ground over which they pass.

19. The lawn mowing apparatus of claim 18 including swivel mounts for the wheels at the front of the side and center decks and at the rear of the rear decks, and non-swivel mounts for the wheels at the rear of the side and center decks and at the front of the rear decks.

20. The lawn mowing apparatus of claim 18 including anti-scalping rollers mounted on the undersides of the decks and projecting below the blades for engagement with portions of the ground which rise above portions contacted by the wheels to prevent the blades from contacting the ground in the event that the heads pass over uneven ground.

21. The lawn mowing apparatus of claim 18 wherein the frame includes a pair of side members and a cross-member, with the side decks being mounted on the side members outboard of the frame, the center deck being mounted on the crossmember and positioned in front of the crossmember, and the rear decks being mounted on the crossmember and positioned to the rear of the crossmember.

22. The lawn mowing apparatus of claim 18 including means for raising the decks to a generally vertical position.

23. The lawn mowing apparatus of claim 18 including hydraulically actuated motors for driving the blades.

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